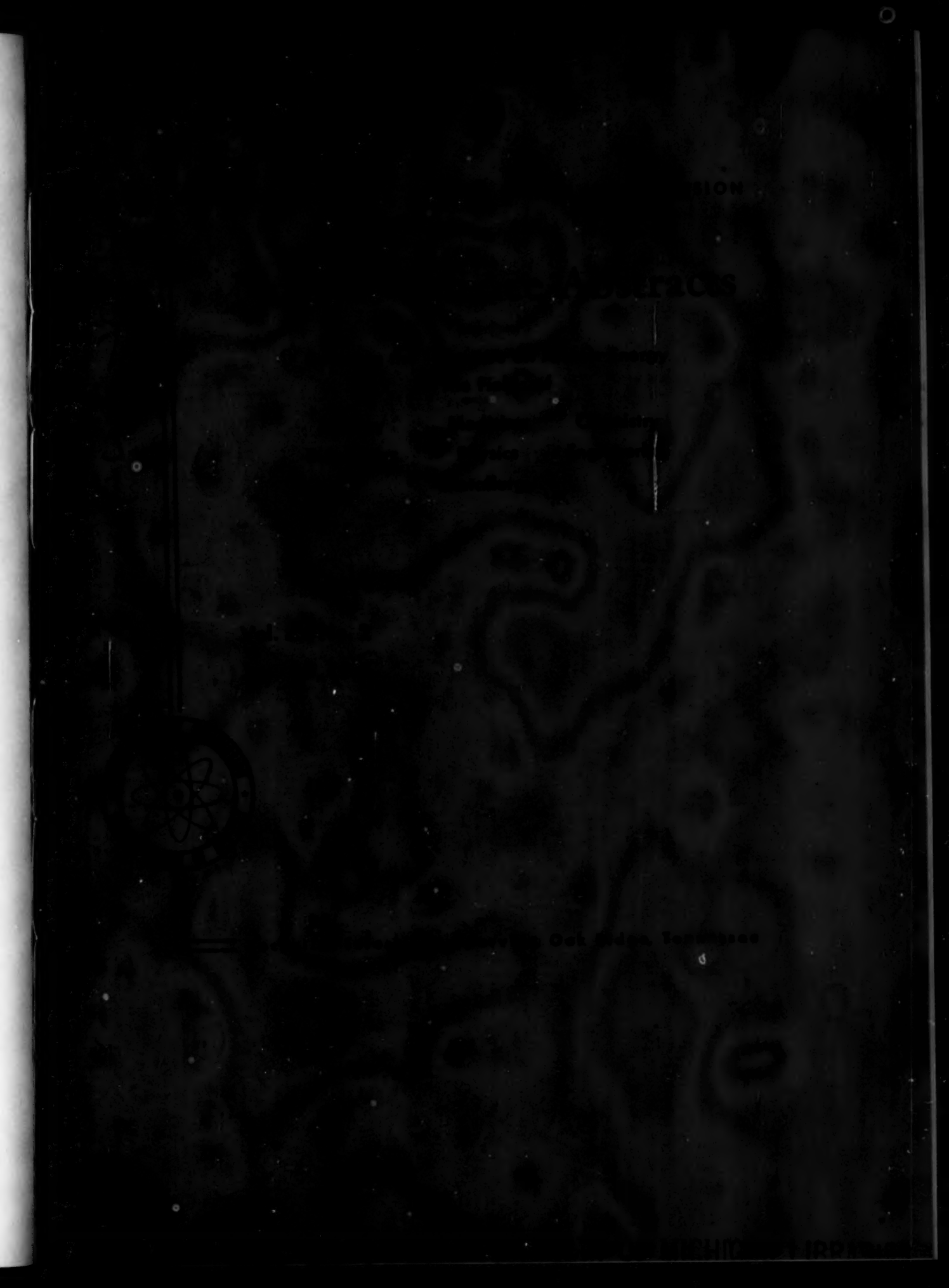

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GENERAL

ATOMIC BOMBS AND WARFARE

283

HOW TO SIZE UP THE ATOMIC BOMB. Part 2. Philip W. Swain. Power 94, 74-9(1950) Nov.

The present article (the second of a series of three) discusses atomic bombs in terms of engineering, mathematics, and physics. The bomb is viewed as a machine to propagate destructive waves of air shock, radiant heat, radioactivity, and gamma rays. Consideration is given to effects delineated by concentric circles, bands of destructivity, and energy of fission.

BIOLOGY AND MEDICINE

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Oak Ridge National Laboratory
STUDIES IN VITRO OF THE EFFECTS OF COLCHICINE ON SPINDLE, CHROMOSOMES, AND CLEAVAGE IN THE GRASSHOPPER NEUROBLAST, WITH SPECIAL REFERENCE TO THE ORIGIN OF THE SPINDLE. Mary E. Gaulden and J. Gordon Carlson. Nov. 14, 1950. 40p. (ORNL-852)

Numerous investigations have demonstrated that colchicine stops mitotic progress in the living cell by deleteriously affecting the spindle structure. Since practically all these investigations have been based on studies of fixed and stained material, it seemed desirable that observations be made of the action of colchicine on the living cell. Studies were therefore made of hanging-drop preparations of living neuroblast cells of the grasshopper (Chortophaga viridifasciata, DeGeer) embryo. It was also desired to compare in detail the action of a physical agent, such as ultraviolet radiation, with a chemical agent, such as colchicine. The effectiveness of colchicine in destroying or preventing the development of the spindle was found to be determined by its concentration and the degree of development of the spindle. The more completely the spindle is developed at the time of exposure, the greater is the concentration required to destroy it or prevent its development. The series of changes in chromosome orientation that takes place during the course of colchicine action can be ascribed to successive stages in the destruction of the spindle. Destruction of the completely formed spindle is accompanied by the accumulation of the spindle material outside the diminishing spindle in a hyaline globule. Interference of colchicine with spindle development leads to the accumulation of the presumtive spindle material, i.e., the karyolymph, in one or more hyaline globules. It is suggested that colchicine does not destroy the spindle material but merely alters its molecular orientation, so that it comes to comprise a spherical mass with no mitotic function. Strong concentrations cause middle and late prophase nuclei to revert to early prophase. Somewhat lower concentrations applied to late prophase nuclei occasionally delay the breakdown of the nuclear mem brane without altering the rate of chromosome contraction. In greatly retarded late prophase nuclei the chromsomes lose their intranuclear orientation, which lends support to the concept that the centromeres normally maintain a fixed position within the nucleus.

RADIATION EFFECTS

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Naval Radiological Defense Laboratory
THE RESPONSE OF MICE TO INOCULATION WITH CERTAIN AVIRULENT BACTERIA AFTER EXPOSURE TO SUBLETHAL TOTAL BODY X-IRRADIATION. I. L. Shechmeister and V. P. Bond. Aug. 11, 1950. 12p. (AD-233(B))

Mice exposed to sublethal doses of x irradiation and subsequently inoculated with live avirulent, or even dead, organisms generically different from the bacteria normally present in the intestines of these animals exhibited a high incidence of bacteremia and death. When avirulent live bacteria were injected, the organisms recovered by sacrifice and culture were either of the strain inoculated or were apparently autogenous bacteria. When heat-killed bacteria were introduced, the recovered organisms were of autogenous origin only. (auth)

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University of California at Los Angeles
THE INFLUENCE OF TEMPERATURE UPON THE DESTRUCTION OF X-RAYED HEMATOPOIETIC CELLS OF TADPOLES. Bennet M. Allen, Ole Arne Schjeide, and Lynette B. Hochwald. Oct. 12, 1950. 17p. (UCLA-93)

The object of this work is to determine the influence of temperature upon the destruction of the hematopoietic cells of tadpoles of Rana catesbiana exposed to a dosage of 500 r hard x rays. Counts in 426 tadpoles were made and the percentage of destroyed cells was determined. Temperatures continuously maintained at different levels from 0 to 11°C hold destruction evenly to a very low percentage which

increases rapidly from 13 up to 33.5°C—the highest temperature tolerated. Experiments at temperatures up to 23°C are upon a basis of 24 hr. The destruction and rapid resorption reaches a maximum at 33.5°C. Low temperatures applied immediately after x-ray treatment are as effective as if applied during and after irradiation, and the rate of destruction increases proportionally to subsequent temperature increase. The destruction rises very slowly in x-rayed tadpoles kept at 4.5 and 10°C through a period of 10 days. Visible destruction of x-rayed hematopoietic cells of tadpoles is due to destructive reactions subsequent to irradiation conditioned by the temperature at which they are reared.

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University of California at Los Angeles
THE RELATION OF MITOSIS TO THE MANIFESTATION OF X-RAY DAMAGE IN HEMATOPOIETIC CELLS OF TADPOLES. Ole Arne Schjeide and Bennet M. Allen. Oct. 2, 1950. 22p. (UCLA-94)

This work is a quantitative test of the concept that hematopoietic cells of the tadpole of Rana catesbiana show visible damage from previously administered 500 r hard x rays only upon entering into mitosis. The mitotic inhibitor colchicine is utilized as an index of rate of division in tadpole tissue. Comparison is made between total cells entering mitosis during a given period and the number of cells developing x-ray damage in the same length of time following exposure. Tadpoles are subjected to several accurately controlled body temperatures for these determinations. Hematopoietic cell destruction following 500 r x rays is found to be directly correlated with rate of cell division during this same time. Rate of mitosis, as well as rate of cell destruction by 500 r x rays is proportional to temperature. However, at 10,000 and 20,000 r the rate of hematopoietic cell destruction exceeds the amount of cell division. Hematopoietic cells appear to sustain initial invisible damage by 500 r x rays during the resting state and perhaps all cellular phases. The visible cell destruction is, however, apparently expressed as a secondary characteristic of the initial damage and seems to appear only at the time of cell division. The mitotic phase at which the first visible indications of damage occur is probably the prophase. Hematopoietic cells held in the late prophase by colchicine are destroyed by 500 r x rays. (auth)

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University of Rochester
THE RELATION OF OXYGEN UPTAKE TO HEMOGLOBIN SYNTHESIS. Jonas E. Richmond, Kurt I. Altman, and Kurt Salomon. [nd.] 4p. (UR-134)

Bone marrows of normal rabbits and rabbits exposed to 800 r of x rays were removed at varying time periods after exposure to radiation. Homogenates were prepared from these marrows and incubated at 38°C in the presence of α-C^{14}-glycine as a hemoglobin precursor. Oxygen consumption and C^{14} activity of the hemin and globin products were determined. The results indicate a difference in the time relation between oxygen consumption and the synthesis of hemin and globin, respectively. Hemin synthesis and oxygen consumption increase considerably in a parallel manner in homogenates from bone marrows removed immediately after radiation, appearing to reach a minimum at about one week after exposure at a time when marked degenerative changes prevail in the marrow. Globin synthesis also increases after radiation, but reaches a maximum 48 hr after irradiation at a time when oxygen consumption already approaches a minimum value. The decay curve of globin resembles in shape that of oxygen consumption and hemin synthesis. Recovery of all three functions commences about 2 to 3 weeks after irradiation.

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BY-EFFECTS OF IRRADIATION ON THE SKIN. Arthur William Stillians. J. Am. Med. Assoc. 144, 743-7(1950) Oct. 28.

Besides the ordinary tanning and burning from ultraviolet light and the more serious effects on the skin of overexposure to α rays or radium, there are other phenomena resulting from the action of radiation on the skin. Some of these are infectious eczematoid dermatitis superimposed on radiodermatitis, acne caused by stimulation of the sebaceous glands, erythema, and the growth of tumors at the border of the exposure area. A histological study of a benign tumor which developed after treatment of an erythematous senile keratosis with radium β rays is presented.

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THE DISTRIBUTION OF X-RAY INDUCED CROSSOVERS FROM CURLY INVERSION HETEROZYGOTES OF DROSOPHILA MELANOGASTER FEMALES. Claude W. Hinton and Maurice Whittinghill. Proc. Natl. Acad. Sci. U. S. 36, 552-8(1950) Oct.

The induced crossover offspring from testcrossed Drosophila females x-rayed with 2250 r as adults were so distributed that their meiotic origin is unlikely. The effects of the x rays were evident for as long as 31 days, with a peak in recombination between 4 and 8 days after treatment. The results are indicative of some oögonial influence upon recombinants.

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EFFECT OF LYMPHOID NECROSIS DUE TO NITROGEN MUSTARD AND ROENTGEN IRRADIATION ON NEUROMUSCULAR FUNCTION OF HYPOPHYSECTOMIZED ANIMALS. Clara Torda and Harold G. Wolff. Am. J. Physiol. 163, 201-8(1950) Oct. 1.

Hypophysectomized rats exhibited a marked decrease of the ability of nerve to maintain the amplitude of action potential during repetitive stimulation, and a decrease of the ability of nerve tissue to synthesize acetylcholine. Roentgen irradiation and administration of nitrogen mustard increased acetylcholine synthesis in hypophysectomized rats about 30%, and increased by about 30% their ability to maintain the amplitude of action potential during repetitive stimulation. Administration of ACTH restored in hypophysectomized rat the acetylcholine synthesis and the ability to maintain the amplitude of action potential to normal. The effect of ACTH in improving the function of nerve is probably dependent only in part on the reduction of the mass of thymus (perhaps also the lymphoid tissue). (auth)

292

EFFECTS OF INTERNAL IRRADIATION OF MICE WITH P^{32}. PART II. GONADS, KIDNEYS, ADRENAL GLANDS, DIGESTIVE TRACT, SPINAL CORD, LUNGS, AND LIVER. Shields Warren, Jane C. MacMillan, and Frank J. Dixon. Radiology 55, 557-70(1950) Oct. (See also NSA 4-6256.)

A study has been made of the histologic damage suffered by a series of mice injected with 25 μc, 250 μc, and 2 mc of P^{32}. The most characteristic and consistent change in the mouse ovary following injection of P^{32} is a reduction in total amount of ovarian tissue. An absolute sterilizing dose of P^{32} short of a lethal dose has not been found for mice. The 250 μc series of mice affords the best opportunity for study of progressive irradiation changes in the testes. Radiation injures first the least mature of the spermatogenic cells, as evidenced by nearly complete loss of spermatogonia after 9 days of irradiation. The kidneys of the animals injected with 25 μc of P^{32} showed no morphologic changes. At 10 days, in the kidneys of the animals injected with 250 μc, there was occasional shrinking of the epithelial cells lining the renal tubules. The adrenals showed no specific radiation effects but slight variable congestion was observed, which was not correlated with the amount of radiation received. With doses of 25 and 250 μc the esophagus and stomach of almost all the experimental animals were apparently unaffected morphologically. In a few instances, small petechial extravasations of blood were noted in the ventral horns of the spinal cord of the mice receiving 250 μc. In addition, at least two large central hematomas extended vertically in the cord. Except for variable degrees of congestion, there were no specific radiation changes in the lungs of any of the animals. The maximum radiation effect on the liver, found about 20 to 50 days after injection, was a tendency toward regeneration of liver tissue shown by numerous mitotic figures in the liver cells. 39 illustrations.

293

INHIBITION OF PLANT GROWTH BY IRRADIATION. V. RADIATION EFFECTS ON INITIATION AND COMPLETION OF GROWTH. Henry Quastler and Marianne Baer. Cancer Research 10, 604-12(1950) Oct.

The observations reported concern linear growth in Mung beans (Phaseolus aureus), including the growth of individual segments and of the entire hypocotyl and the first segment of the epicotyl in normal plants, after resection of various parts, and after total or partial irradiation with various doses of x radiation. Irradiation with x rays causes three distinct effects: temporary inhibition of growth completion and permanent reduction of the capacities both for initiating and completing growth. Permanent stunting is an effect of local irradiation. An analysis of dose-response relations shows that the apparatus for growth initiation is more vulnerable than the apparatus concerned with actual growth.

294

Atomic Energy Research Establishment
PRELIMINARY ESTIMATE OF THE ENERGY DEPOSITION IN SOFT TISSUE DUE TO A FAST NEUTRON FLUX. B. Davison. [nd.] 34p. (AERE-T/M-13; H.S. 1467)

The energy deposition in soft tissue due to a fast-neutron flux is examined for the following three extreme models: Model A assumes that after a hydrogen collision the mean free path of a neutron reduces to zero, i.e., all the further collisions take place at the same spot as the first collision with hydrogen. Model B assumes that the mean free path for all energies is the same as for the initial energy, and in all collisions neutrons are scattered isotropically. Model C assumes that on a collision with hydrogen a neutron either loses all its energy or continues to move with the same energy and in the same direction as before the collision. It is shown that the correct answer should be between the limits set by these three models. For each model the spatial distribution of energy deposition is determined for the case when the human body is replaced by a half-space consisting of soft tissue with neutrons from outside either falling at right angles to the exposed surface, or coming from an isotropic plane source. The total amount of energy deposition in the body, the density of energy deposition at the exposed surface, and the mean depth of energy penetration are tabulated for the three models mentioned above for the initial neutron energy range from 0.5 to 5.0 Mev. (auth)

295

PYRIDOXINE AND EXPERIMENTAL X-RADIATION INJURY IN RATS. M. L. MacFarland, M. V. Peters, R. M. Ballantyne, and E. W. McHenry. Am. J. Physiol. 163, 394-9(1950) Nov. 1.

To investigate a possible relationship between pyridoxine insufficiency and x-ray injury, the effects of total-body irradiation on pyridoxine-deficient rats and on rats receiving this factor were compared. Pyridoxine deprivation was not found to increase the susceptibility of rats to x-ray damage and irradiation did not affect the concentration of total vitamin B_6 in the livers of either deficient or control animals. (auth)

296

RADIATION-INDUCED MUTATIONS IN MAMMALS. Donald R. Charles. Radiology 55, 579-81(1950) Oct.

The seriousness of the effects of radiation-induced mutations is considered. Data on the mutation rates and types of genetic changes induced in mice by repeated small exposures of x-rays and neutrons is presented. New mutations occur in about 1% of mouse sperm for each 100 r of exposure at low-dosage rate. Of these mutations, about 40% would perhaps not be a real health hazard to individuals inheriting them. Another 40%, the recessives, would not be apparent for probably many generations. Only 20%, the dominants, would have immediate effects on offspring receiving them. The death rate caused by semi-sterility mutations in humans has been estimated by studying the time equivalence between mouse and human development. The tentative conclusion is reached that women with inherited semi-sterility would lose half their offspring in the embryonic period, before the 7th week, and so presumably without really serious effects.

RADIATION HAZARDS AND PROTECTION

297

Brookhaven National Laboratory
PROTECTION OF BIOLOGICAL SYSTEMS FROM THE EFFECTS OF IONIZING RADIATION. Leslie F. Nims. [nd.] 7p. (AECU-972)

A general discussion is presented of the physical, chemical, and biological aspects of radiation damage, and of possible methods of protection. It is impossible to protect biological systems from the physical effects of ionizing radiation. Protection can be achieved against some of the chemical oxidations resulting from radiation, but the protecting substances must be present during the exposure for the major protective effect. Further studies on the biological mechanisms damaged by radiation give some hope of developing a rational therapy for the radiation syndrome.

298

Naval Radiological Defense Laboratory
CHAPTER 10 - DECONTAMINATION; RADIOLOGICAL DEFENSE, VOL. II. William H Sullivan. Feb. 1, 1950. 36p. (AD-206(Y))

Decontamination of radioactive areas or objects requires only the modification of conventional equipment and techniques. Complete elimination of the radioactivity is not necessary, only reduction to a level determined by the time personnel must remain in the vicinity and other factors. Three basic procedures may be used for decontamination: (1) surface decontamination, (2) aging and sealing, and (3) disposal. Large clearing operations may call for the use of all three of these procedures. The purpose of surface decontamination is to remove the radioactive contamination without impairing the utility of the contaminated object. The most readily available methods are those employing vacuum cleaning, water, steam, detergents, complexing agents, organic solvents, acids, caustics, or abrasion. Sealing operations are undertaken after the activity of the object has been reduced by natural decay (aging). The residual contamination is sealed in by using common surfacing materials and techniques. Asphalt is applied to roadways and open-land areas by road repaving operations; paints and plastics are applied to vertical and overhead surfaces by spraying techniques; grout is applied to concrete surfaces by the Gunite process. Disposal operations clear areas by removing contaminated objects. To reduce the volume of material that should be stored, it is often necessary to demolish objects, separate contaminated from uncontaminated materials, and burn contaminated combustibles under carefully controlled conditions. In handling the contaminated material thus concentrated, maximum personnel protection should be provided and contamination of new areas prevented. The radioactive waste should be stored where it can be inspected or recovered: it can be buried on land, entombed, or buried at sea. These operations are described in detail in this chapter.
20 figures.

299

Kellex Corporation
GAS DECONTAMINATION PROJECT STATUS; THIRD QUARTER; JULY 1 - SEPTEMBER 30, 1950. W. A. Bain. Oct. 27, 1950. 80p. (KLX-1316)

Under this project the applicability of certain particle-conditioning techniques to gas streams containing radioactive particulate matter has been investigated for the purpose of improving the clean-up efficiencies of commercially available separators such as cyclones and scrubbers used in wet removal systems. It was found that under optimum conditions a sodium chloride aerosol could be built up to the extent that less than 1% of the mass passed through the analytical cyclone and jet impinger, which was designed to remove particles greater than 5 and 2 μ, respectively, (99% build-up above 2 μ). These results were achieved with steam injection of 10 lb per 1000 cu ft and multiple water fog injection of 13 lb per 1000 cu ft followed by sonic agglomeration at 800 cycles for 12 sec. Somewhat less desirable results (98.2% build-up to above 2 μ) were obtained with multiple water fog injection and sonic agglomeration alone. Tests of the commercial type separators, cyclone and Peabody scrubber, indicate that they are capable of efficiently separating particles of the type investigated which have been built up to 2 μ or higher. Build-up techniques applied to a water insoluble silver iodide suspension (0.8 μ maximum particle size, 0.3 μ average particle size, with loading of 0.3 grains per 1000 cu ft) were less effective than with sodium chloride, the maximum build-up to above 2 μ particle size being only 83%. The factors controlling build-up in this case are obscure. On the basis of this work, it would appear that about 98% of the mass of particulates can be removed from an aerosol of the types employed in this investigation by building up particle size with water fog injection and sonic agglomeration with particle removal by a cyclone separator. The cost has been estimated.

300

EFFECTS OF EXTREME HEAT ON MAN. PROTECTION OF MAN AGAINST CONFLAGRATION HEAT. Konrad Buettner. J. Am. Med. Assoc. 144, 732-8(1950) Oct. 28.

This article appeared as a USAF School of Aviation Medicine report and was abstracted in NSA as abstract 4-3294.

RADIOTHERAPY

301

CANCER OF THE THYROID IN CHILDREN: A REPORT OF 28 CASES. B. J. Duffy, Jr., and P. J. Fitzgerald. J. Clin. Endocrinol. 10, 1296-1311(1950) Oct.

Radioautographic studies of the uptake of I^{131} by thyroid carcinomas suggest that such cancers in children or adolescents possess greater capacity for concentrating radioiodine than do similar lesions in adults. Nine of the 28 cases had been submitted to low-voltage x-ray therapy for "enlarged thymus" between the ages of 4 and 18 months. Further investigation to discover if a possible radiation-cancer cause-and-effect situation exists is recommended.

302

CARCINOMA OF THE CERVIX. TRENDS IN TREATMENT. Robert A. Hays and U. V. Portmann. Cleveland Clinic Quart. 17, 242-51(1950) Oct.

Particular attention is paid to the dosage used and to the tolerance limits of the uninvolved tissues in radium and roentgen therapy in this general discussion of modern trends in treatment of cancer of the cervix uteri.

303

DOSAGE CALCULATOR FOR LINEAR GAMMA-RAY SOURCES WITH UNEVEN DISTRIBUTION OF ACTIVE MATERIAL. J. Falding Richardson. Brit. J. Radiology 23, 642-8(1950) Nov.

Calculations have been made of the relative linear strengths of adjacent sections of linear γ-ray sources in which the active material is unevenly distributed, to obtain an improved distribution of dose. The method of calculation is outlined, and general formulas are obtained for sources in which the linear strength is increased either at one end or at both ends. A special case is examined in which 1 cm at each end of the sources is "loaded." Rules are given for the treatment, by radon needles of this type, of rectangular areas which cannot be treated by the normal methods. (auth)

304

I^{131} IN THE DIAGNOSIS AND TREATMENT OF HYPERTHYROIDSIM. R. A. Shipley, J. P. Storaasli, H. L. Friedell, and A. M. Potts. Am. J. Roentgenol. Radium Therapy 64, 576-89(1950) Oct.

In a series of 29 diffuse goiters treated with a mean dose of 95 μc of I^{131} per g of thyroid, 78% were controlled, 15% failed to respond to a single dose, and 7% relapsed. Myxedema occurred in 15%. The gland usually returned to normal size. Of a group of 18 cases of nodular goiter treated with a mean dose of 135 μc/g, 83% were controlled, 17% failed to respond, and there were no cases of relapse or of myxedema. The gland usually did not return to normal size. It was not possible to relate the occurrence of poor response or of myxedema with the size of dose given, the severity of the disease, or the size of the gland. It is believed that variations in response may be largely due to differences in homogeneity of uptake among various follicles of the gland. The mean retention of radioiodine in euthyroid subjects, as measured by urinary excretion, averaged 45%, and in the presence of thyrotoxicosis, 83%. Considerable overlap occurred between normal and thyrotoxic subjects. In a subgroup of patients with toxic goiter, the retention by direct count averaged 69% as compared to 81% when determined by urinary assay. The thyroid "collection rate" does not give a satisfactory differentiation of normal and thyrotoxic cases when it is calculated on the basis of two 24-hr urine samples collected during the first 48 hr. Adequate values for "collection rate" could undoubtedly be obtained if two or three separate collections were made during the first 12 to 24 hr.

305

THE NASOPHARYNGEAL APPLICATOR. Harold W. Jacox. Radiology 55, 593-4(1950) Oct. (Editorial)

An evaluation of the problems associated with the use of the nasopharyngeal radium-β-ray applicator is given, and advantages and limitations of the method are discussed.

306

A NOTE ON THE USE OF WEDGE FILTERS IN TRANSPARENT-ENDED X-RAY THERAPY APPLICATORS. M. H. E. Hulbert and A. C. Groom. Brit. J. Radiology 23, 649-52(1950) Nov.

A description is given of the use of removable wedge filters at the top diaphragm of standard transparent-ended x-ray therapy applicators, with details of construction and resulting isodose curves. (auth)

307

RADIATION DOSIMETRY IN THE TREATMENT OF FUNCTIONAL THYROID CARCINOMA WITH I^{131}. L. D. Marinelli and Ruth F. Hill. Radiology 55, 494-502(1950) Oct.

A description is given of methods by which dosage in I^{131} therapy of metastatic thyroid cancer can be estimated not only for the tumor but for certain other organs and for the body as a whole. A rough estimate of the maximum possible radiation doses delivered to blood, kidney, mouth, and stomach in patients undergoing therapy with I^{131} has been attempted on the basis of the radioactivity found in blood, urine, saliva, and gastric juice. It is found that, on the average, a total-body radiation dose of 108 er (equivalent roentgens) results from the administration of 100 mc of I^{131}, but that individual variations may shift this value by a factor as great as three in either direction. For the same amount of I^{131}, the average maximum "kidney" dose is 757 er, the average maximum "gastric" dose is 771 er, and the average maximum "mouth" dose is 2020 er. These doses, however, must be considered as applying to very limited regions of the organs.

308

RATIONALE OF THERAPY OF BLOOD DISEASES. William Appel. J. Michigan State Med. Soc. 49, 1188-90, 1204(1950) Oct.

A general discussion of the treatment of hemorrhagic diseases, anemia, and leukemia including the use of x rays, P^{32}, and nitrogen mustard is presented.

309

SOME OBSERVATIONS WITH 1,000-KV, 400-KV, AND 200-KV X-RAY THERAPY. Walter T. Murphy and M. C. Reinhard. Radiology 55, 477-93(1950) Oct.

During the course of routine treatment of malignant neoplasms of the pelvic region, much information on radiation effects and techniques of x-ray and radium therapy has been collected. Curves are presented showing the treatment time–skin dose relationship for 200-, 400-, and 1000-kv radiation. The effects of varying the increments of treatment time and dosages are described. Comparisons of skin and subcutaneous reactions produced in the same patient by 200 and 1000 kv showed that for equal total dosage and treatment time, the immediate reactions were similar. The 200-kv radiation produced a greater number of late

skin and subcutaneous reactions than did the 1000-kv radiation. Tissue doses at depth as a function of the treatment time for the three qualities of radiation are presented graphically. Associated with increased depth doses is an increase in the number of bladder and rectal complications. Clinical end results following irradiation of cervical carcinoma showed the advantage of 1000-kv over 200-kv radiation. This is particularly true in the case of a large pelvis. A selected group of Stage II and Stage III cases showed a 3-year controlled disease percentage of 58.5 for 1000-kv and 45.6 for 200-kv radiation.

310

A SYSTEM OF DOSAGE ESTIMATION FOR THE TANGENTIAL IRRADIATION OF THE BREAST WITHOUT BOLUS. K. H. Clarke. Brit. J. Radiology 23, 593-7(1950) Oct.

An investigation has been made into the x-ray dosage distribution resulting from the irradiation of the breast by two tangential fields not filled with bolus, and graphs have been drawn which enable the mean surface dose over the breast or chest wall to be predicted with an accuracy of about 3%. The method can be applied to all cases, both pre- and post-operative. Details are also given of the possible variation of skin dose about this mean value and of the dose distribution to be expected within the breast. This system of dosage estimation necessitates two measurements of the patient being made, and a simple instrument is described which enables this to be done easily and quickly. (auth)

311

TOXIC GOITER COMPLICATING DIABETES MELLITUS TREATED WITH RADIOACTIVE IODINE (I^{131}). Barkley Beidleman. J. Am. Med. Assoc. 144, 925-7(1950) Nov. 11.

In a case of diffuse toxic goiter complicating diabetes mellitus treated with radioactive iodine, I^{131}, the insulin requirement and the lack of diabetic control were directly proportional to the basal metabolic rate under the various conditions described. Successful treatment of the thyrotoxicosis with radioactive iodine failed to reduce the insulin requirement below that of the prethyrotoxicotic level. (auth)

312

THE TREATMENT OF EUTHYROID CARDIAC PATIENTS WITH INTRACTABLE ANGINA PECTORIS AND CONGESTIVE FAILURE WITH RADIOACTIVE IODINE. A. Stone Freedberg, Herrman L. Blumgart, George S. Kurland, and David L. Chamovitz. J. Clin. Endocrinol. 10, 1270-81(1950) Oct.

The therapeutic results of hypothyroidism induced by radioactive iodine, I^{131}, in 23 euthyroid patients with intractable advanced angina pectoris or congestive failure are reported. Each patient received orally a total of from 25.5 to 176 mc of I^{131} in single or divided doses. The largest single dose was 56 mc. No radiation sickness and no toxic effects on the blood or kidneys have been observed. There was no thyroiditis in 10 patients, mild or moderate transitory thyroiditis in 18, and severe thyroiditis in only 1. Temporary mild hyperthyroidism occurred in 2 patients. Angina pectoris has been strikingly lessened or abolished in 11 of the 17 patients with intractable cardiac pain. Concomitant congestive failure, present in several of these patients, was likewise improved. In the other 6 of the 17 patients, angina pectoris was relieved when the patients were myxedematous but recurred when desiccated thyroid was administered in order to ameliorate the discomfort of myxedema. Four of 6 patients, incapacitated primarily because of congestive heart failure, have shown worthwhile improvement; in 3 of these the improvement has been striking. Final evaluation of this therapy must await prolonged study. At present it can be said that many months of worthwhile existence already have been added to the lives of these disabled cardiac patients who were refractory to all standard forms of medical therapy.

313

THE USE OF RADIOACTIVE PHOSPHORUS IN THE TREATMENT OF CARCINOMA OF THE BREAST WITH WIDESPREAD METASTASES TO BONE. Hymer L. Friedell and John P. Storaasli. Am. J. Roentgenol. Radium Therapy 64, 559-75(1950) Oct.

The studies presented are essentially of a preliminary nature to determine whether P^{32}, administered to patients with widespread metastatic carcinomatosis of bone, would produce in some readily observable fashion amelioration of the terminal state of this disease. Since the selectivity in tumors is not great, large amounts of radiophosphorus are necessary. To extend these doses to still higher levels would appear to be a drastic and heroic form of treatment. The most important complication of intensive P^{32} treatment is a severe depression of the hematopoietic system, and in the dosages used in these cases, sharp, and in some instances alarming, depression of the blood elements occurred. Of the 12 patients treated in this series, two patients showed objective improvement in the appearance of the osseous lesions as evidenced by recalcification on roentgen studies. There was definite relief from pain in all but two cases. Increase in longevity was not established, although the first patient lived for 6 years. It appears that patients who have widespread bone metastases from carcinoma of the breast may expect relief from pain, and occasional regeneration of invaded bone, in intensive treatment with radiophosphorus.

314

AN X-RAY TUBE MOUNTING FOR CONVERGENT THERAPY GIVING HIGH PERCENTAGE DEPTH DOSE BEAM. W. Kollibay. Brit. J. Radiology 23, 653-5(1950) Nov.

An x-ray therapy tube mounting is described by which the radiation is made to converge on one point from many angles by means of an even movement of the focus of the x-ray tube over a section of a sphere, the beam constantly pointing to the center. A shockproof shield of small dimensions and weight with an oil-immersed tube is described. The shield is designed for 220-kv constant potential at 20 ma, and weighs only 80 lb. Depth-dose distribution and isodose curves are given, and the many advantages of convergent-beam irradiation are described.

TOXICOLOGY STUDIES

315

Southern Research Institute
STATUS REPORT NO. 8 ON BODY RETENTION OF CARBON-14 TO ATOMIC ENERGY COMMISSION; DIVISION OF BIOLOGY AND MEDICINE; PROJECT NO. 121. Oct. 9, 1950. 20p. (AECU-1014; Status Report No. 8)

A new series of long-term experiments designed to obtain information on the degree of radiation in the area of the bone shaft where $C^{14}O_2$ is laid down following a single exposure are under way. An experiment which entailed exposure of mice to a very active $BaC^{14}O_3$ aerosol followed by tissue-activity determinations, lung autoradiographs, and measurement of the exhaled CO_2 activity is described. Preliminary results indicate very rapid exchange of barium carbonate carbon with inactive carbonate ions in the lung as was to be expected. Studies on the effect of repeated injection of C^{14}-labeled formate (a rather specific precursor of nucleic acid moieties) on the pattern of leukemia in Ak-4 mice are under way. Monthly doses of 50 μc of C^{14} formate per mouse are being employed. Such a dose has been found to give tissue activities of 50 μc/mole of carbon, and nucleic acid purine activities of 1800 μc/mole of carbon at 6 hr after injection. The short-term distribution of formate carbon in tissues and organs has been investigated. Over-all distribution and excretion studies have been carried out with methyl-labeled nitrogen mustard and 2,6-diaminopurine labeled in the 2 position.

316

Naval Radiological Defense Laboratory
A QUANTITATIVE STUDY OF PERCUTANEOUS ABSORPTION. II. TOXICITY AND EFFECT UPON ABSORPTION OF TWO DECONTAMINATING SOLUTIONS. R. Kenneth Loeffler and V. Thomas. Oct. 2, 1950. 16p. (AD-254(B); Technical Objective AW-06)

Two solutions which have previously been proposed for skin decontamination, each consisting of a complexing agent, a wetting agent, and a disinfectant, are investigated for toxicity in rats. Some systemic toxicity is demonstrated, even from local applications. The solutions are shown to be good skin decontaminants, but it is also shown that they tend to increase the percutaneous absorption of $Sr^{89}Cl_2$ under several conditions. Data are presented which are interpreted as showing that, immediately upon contact with normal intact rat skin, some material is irreversibly bound in a manner which causes it to be eventually absorbed into the system. (auth)

317

University of California at Los Angeles
THE ULTIMATE SITE OF SKELETAL DEPOSITION OF Sr AND Pb. N. S. MacDonald, Florita Ezmirlian, Patricia Spain, and Clare McArthur. Nov. 6, 1950. 25p. (UCLA-96)

X-ray diffraction studies were made on the bone ash of rats receiving repeated injections of $SrCl_2$ and of Pb acetate. Debye powder patterns showed no evidences of a second solid phase, even in bone samples containing as much as 8% Sr or 5% Pb. Determinations of the unit cell dimensions were made with a precision of 0.01% using a symmetrical focusing back reflection camera. These determinations showed definite distortions of the normal apatite-like lattice due to the presence of the foreign ions. It is concluded that when Sr or Pb are accumulated by skeletal tissue, some and perhaps most of the foreign cations ultimately become part of the crystalline structure of the bone salt. (auth)

318

University of California Radiation Laboratory
STUDIES OF THE METABOLISM OF CERTAIN FISSION PRODUCTS AND PLUTONIUM. Bergene Kawin, D. H. Copp, and J. G. Hamilton. Aug. 7, 1950. 120p. (UCRL-812)

The distribution and excretion of radioisotopes of cerium, niobium, plutonium, strontium, yttrium, and zirconium has been studied in adult female rats of the Long-Evans strain. The metabolism of Pu(VI) was unaltered by general treatment with the sulfhydryl compounds 2,3-dimercaptopropanol (BAL) and cysteine. This suggests that the metabolism of Pu is not related to that of sulfhydryl groups. These compounds do not appear to have use as therapeutic agents for plutonium poisoning. Cysteine appeared to increase the amount of Pu retained at the site of intramuscular injection. Parathormone had no significant effects on the distribution and excretion of either Pu or Y. The resorption of bone by parathormone did not appear to labilize these bone-deposited elements, nor make them more susceptible to the positive effects of zirconium citrate. Massive doses of zirconium citrate appeared to have some positive effects on the distribution and excretion of Ce, Nb, Pu, and Y. Sodium citrate had relatively little effect on the metabolism of these elements, with the exception of Y. Both citrates were without significant effect on the metabolism of radiostrontium. Zirconium citrate may alter the metabolism of the several radioisotopes through a "carrier" action as a chelated radiocolloidal citrate complex. The possible influence of this complex on the uptake and excretion of the several radioisotopes during the first hour following their administration has been discussed. (auth)

319

University of Rochester
THE EXPERIMENTAL PRODUCTION OF TOLERANCE AND OSTEOSCLEROSIS BY REPEATED INTRAVENOUS INJECTIONS OF BERYLLIUM SULPHATE. James Scott. July 17, 1950. 12p. (UR-125)

Beryllium sulfate was administered to rats intravenously at weekly intervals over a period of 12 to 14 weeks. Tolerance was indicated by the following: (1) pretreated animals could tolerate doses which would be fatal to untreated animals, (2) only the first doses produced marked decrease in weight, and (3) the clinical signs of toxicity were observed only after the first few injections. The only permanent anatomical lesion produced was an osteosclerosis. Some data are given on total amount of beryllium retained in the animals. It is concluded that a mild degree of tolerance to beryllium sulfate can be induced but probably not to the degree or of the importance observed with some other metals, and that a fairly large amount of beryllium can be stored in the body in such a state that it is relatively nontoxic.

320

THE EFFECT OF BERYLLIUM ON CERTAIN ENZYMES. Friedrich W. Klemperer. J. Biol. Chem. 187, 189-96(1950) Nov.

The effect of beryllium on various enzymes was tested. The element had no effect on the respiration of liver slices. Succinic oxidase was activated by beryllium; this activation was similar to that which is caused by aluminum. Beryllium does not inhibit glycolysis in muscle extracts; it cannot replace magnesium as an activator of this reaction. Adenosinetriphosphatase, carboxylase, arginase, carbonic anhydrase, and uricase are not inhibited by beryllium. In the absence of calcium there was slight activation of adenosinetriphosphatase by beryllium. Carboxylase and arginase are not activated by beryllium in the absence of other activating metals. The previously reported inhibitory action of beryllium on alkaline phosphatase appears to be specific. (auth)

321

AN INTRODUCTION TO THE NONCLASSIFIED LITERATURE DEALING WITH BIOCHEMICAL STUDIES OF EXPERIMENTAL URANIUM POISONING. Samuel Schwartz and Elaine J. Katz. In Toxicology of Uranium; Survey and Collected Papers, Albert Tannenbaum, ed. New York, McGraw-Hill Book Company, Inc., 1951. (NNES Div. IV, Vol. 23, Paper 13, pp.262-73)

The nonclassified literature dealing with the biochemical effects of uranium poisoning has been reviewed. Representative studies of various tests have been noted with special reference to the literature of the past two decades. Most of these tests are based on alterations in kidney function. Chief emphasis has been given to nitrogen retention, acidosis, albuminuria, and abnormalities in special renal-clearance tests. Although the latter appear to be sensitive and reliable indices of kidney dysfunction, several authors have pointed out that the classical interpretation of these tests does not hold in uranium poisoning; inulin clearance, for example, may be markedly diminished even when the glomeruli appear essentially normal histologically. This is believed to be due to increased back-diffusion of inulin through the damaged tubules. Nearly all the studies that have been reported are based on dog and rabbit experiments. 61 references. (auth)

TRACER APPLICATIONS

322

Michigan State College of Agriculture and Applied Science
HORMONAL AND NUTRITIONAL FACTORS WHICH ALTER THE EFFECTIVE HALF-LIVES AND DIFFERENTIAL ABSORPTION RATIOS OF CALCIUM, MANGANESE, AND COBALT IN THE ANIMAL BODY; SEMI-ANNUAL REPORT. L. F. Wolterink and E. P. Reineke. Feb. 20, 1950. 14p. (AECU-1015)

In pair-fed rats as little as 10 μg of thyroxine daily for two weeks, an amount only slightly in excess of their own secretion rate, increased the rate of calcium turnover in the liver and the retention of calcium by the femur. Thiouracil had the opposite effect. In addition, thiouracil made the animals extremely sensitive to the subcutaneous radiocalcium chloride injections, particularly if the animals were on a vitamin D assay diet. If shock occurred, there appeared to be a diversion of the calcium to the lungs and liver. Daily subcutaneous injections of 10 μg of the dimethyl ether of stilbestrol had no effect on calcium turnover although this treatment usually depresses iodine turnover in the thyroid. Vitamin B_{12} administration to deficient chicks and pigs usually increased iodine turnover in the thyroid. When administered to normal rats or mice, iodine uptake by the thyroid was reduced. The effect of vitamin B_{12} on calcium retention is currently being investigated in the light of its antithyrotoxic effects. Cobalt turnover will then be studied. (auth)

323

Naval Radiological Defense Laboratory
A QUANTITATIVE STUDY OF PERCUTANEOUS ABSORPTION. I. ABSORPTION OF RADIOSTRONTIUM CHLORIDE IN MINUTE QUANTITIES THROUGH INTACT AND MECHANICALLY DAMAGED RAT SKIN. R. K. Loeffler and V. Thomas. June 15, 1950. 25p. (AD-225(B))

A per cent-time relation study is made of the systemic absorption of minute quantities of neutral, soluble radiostrontium Sr^{89} through intact, abraded, and lacerated skin of rats, and from wounds made by contaminated blades. It is found that the absorption is very rapid in all cases, much of the uptake taking place in the first 10 min, and practically all within the first 0.5 hr. Slightly more than 10% of the contaminant is absorbed through intact skin, and nearly 50% reaches the body interior when the continuity of the outer skin layers is broken. The type and degree of the discontinuity appear to be of little significance. Three hundred r of x irradiation given 24 hr prior to contamination had little or no effect on the absorption through abraded skin. The absorption rate was used as a test of the rate at which rat skin recovered after the outer layers were scraped off. It was found that absorption rates through abraded skin, after 8 hr of healing were almost the same as those through normal skin.

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University of California Radiation Laboratory
SUMMARY OF THE RESEARCH PROGRESS MEETING, MAY 4, 1950. Henry P. Kramer. Aug. 22, 1950. 10p. (UCRL-717)

Studies on C^{14}-labeled Glycine in Man. N. Berlin. The primary objection to the use of tracer C^{14} in humans has been the possibility of unknown low-dosage long-exposure effects. However, experiments with mice have shown that the turnover rate for proteins is surprisingly fast and that C^{14} has a biological half life of about 10.5 days. On the basis of these findings the metabolism of C^{14}-labeled glycine in humans has been studied. The exhaled $C^{14}O_2$ activity curve could be resolved into three linear components with half lives of 2 to 4 hr, 10 to 20 hr, and 7 to 11 days, each carrying about 30% of the administered activity. The total-hemoglobin specific-activity curve indicates a red-cell lifetime of 120 days. C^{14} activity has been found incorporated in albumin within 3 min after intravenous injection.

The New Element Californium. K. Street, S. Thompson, A. Ghiorso, and G. T. Seaborg. Some of the problems involved in predicting the chemical properties of element 98

and the nuclear properties of its isotopes, and of devising efficient experimental procedures for producing and identifying the new element are briefly discussed.

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University of California Radiation Laboratory
THE RELATION OF PHOTOSYNTHESIS TO RESPIRATION. J. W. Weigl, P. M. Warrington, and M. Calvin. July 20, 1950. 30p. (UCRL-811)

The information in this report has been taken from report UCRL-590 (see abstract NSA 4-6533) in which the experiment is discussed in greater detail, and in which the apparatus used is illustrated and its operating characteristics are given. Some additional comments are made in the present report concerning the experimental conditions and results.

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University of California Radiation Laboratory
SUMMARY OF THE RESEARCH PROGRESS MEETING OF MAY 18, 1950. Henry P. Kramer. Sept. 18, 1950. 6p. (UCRL-889)

Current Applications of C^{14} to Organic and Biological Chemistry. B. Tolbert. The methods that are available for the incorporation of C^{14} in organic compounds are limited by the factors of high cost of the radioactive material and extreme purity desired in the organic compounds. Three primary reactions are employed, each of which engenders a large class of substances that are useful in biological work: $C^*O_2 \rightarrow C^*H_3I$ (80 to 90% yield); $C^*O_2 \rightarrow C^*N^-$ (80 to 90% yield); $C^*O_2 \rightarrow R^*CO_2H$ (95 to 98% yield). C^*H_3I is useful because of the many coupling possibilities that it offers. It is used in the preparation of acetylcholine. R^*CO_2H is the intermediate for the production of amino acids. Eleven amino acids have thus far been prepared with the C^{14} label in various positions. Among these are glycolic acid, lactic acid, succinic acid, and tartaric acid. Studies are being carried out on the action of drugs labeled with C^{14}. To date, methadone, codeine, demerol, stilbamidine, and acetylcholine have been synthesized. Work is also being carried out on possible isotope effects by studying the breaking up of malonic acid into CO_2 and CH_3COOH. It was found that when one of the formate radicals was labeled with C^{14}, 5% more C^{14} was contained in CH_3COOH than would be expected if the bonds $C^{14}-C^{12}$ and $C^{12}-C^{12}$ were of equal strength. H^3-labeled cholesterol has been prepared and attempts are under way to tag it with C^{14} as well. Stilbadeine labeled with C^{14} is of interest in connection with multiple myeloma, a cancer of the bone marrow. It has been observed that stilbadeine concentrates in the marrow. This fact opens the possibility of treating myeloma by means of the radiation from C^{14}-labeled stilbadeine.

On the Crystal Structure of UB_4. D. Templeton. The borides of heavy metals have attracted the efforts of investigators because of their great stability at high temperatures and their hardness. CeB_x, ThB_x, and UB_x were prepared by heating the metals in the presence of boron to about 1500°C. These compounds were examined and in them a new crystal lattice was observed by means of x-ray diffraction. The results of this work are reported in detail in AECD-2762 (see NSA 4-1415).

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THE CHEMICAL ANALYSIS OF PURIFIED INFLUENZA VIRUS A (PR8 STRAIN) CONTAINING RADIOACTIVE PHOSPHORUS. A. F. Graham. Can. J. Research 28E, 186-95(1950) Oct.

Purified influenza virus A (PR8 strain) was found to contain about 11% phospholipid and 5% nucleic acid in agreement with previously reported work. The nucleic acid fraction contained 4.5% pentose nucleic acid and 0.3% desoxypentose nucleic acid. When influenza virus was grown in the allantoic membrane of the embryonated egg in the presence of inorganic radioactive phosphorus, P^{32}, both phospholipid and nucleic acid components of the virus were found to contain the isotope. The specific radioactivity of the nucleic acid fraction was about four times that of the phospholipid. (auth)

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DEPOSITION OF RADIOACTIVE CALCIUM IN RACHITIC AND NONRACHITIC CHICK TIBIA FROM ORAL AND INTRAMUSCULAR DOSES OF Ca^{45}. B. B. Migicovsky and A. R. G. Emslie. Arch. Biochem. 28, 324-8(1950) Oct.

Experiments on the deposition of calcium in rachitic and nonrachitic chick tibia from oral and intramuscular doses of Ca^{45} indicate that vitamin D does not exert a direct effect on the mineralization of bones of chicks.

329

DEPOSITION OF RADIOGALLIUM (Ga^{72}) IN PROLIFERATING TISSUES. H. C. Dudley, G. W. Imirie, Jr., and J. T. Istock. Radiology 55, 571-8(1950) Oct.

Radiogallium, Ga^{72}, has been shown to concentrate at areas of osteogenic activity, i.e., the epiphyseal junction and the callus of healing fractures in rabbits, and in osteogenic sarcoma of the mouse. In certain fibroadenomas, fibrosarcomas, and mixed mammary tumor of animals, no significant localization of Ga^{72} occurred. Autoradiographic studies of the deposition of Ga^{72} in bone, by impregnation of bone sections with liquid photographic emulsion, has made possible more detailed localization of this element. It is suggested that radiogallium citrate is worthy of clinical trials in tracer amounts for diagnostic purposes and at higher levels for possible therapeutic effect. (auth)

330

THE DISTRIBUTION OF COBALT IN POLYCYTHEMIC RATS. Nathaniel I. Berlin. J. Biol. Chem. 187, 41-5(1950) Nov.

The distribution of injected Co^{60} in the liver, spleen, kidney, lung, blood, and bone marrow of polycythemic rats is presented. The cobalt rapidly reaches a saturation level in the liver, kidney, and lungs, and, with a trend toward a slow increase in the red blood cells, in the spleen and bone marrow on prolonged administration. (auth)

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THE DISTRIBUTION OF RADIOACTIVITY FOLLOWING THE FEEDING OF CARBON 14-LABELED 2-ACETYLAMINOFLUORENE TO RATS. Harold P. Morris, John H.

Weisburger, and Elizabeth K. Weisburger. Cancer Research 10, 620-4(1950) Oct.

The distribution of radioactivity was studied in rats following oral administration of a single dose of 2-acetylaminofluorene-9-C^{14} at 2 and 6 hr, and 2-acetylaminofluorene-ω-C^{14} at 6 hr.

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EFFECTS OF ADRENAL AND GONADAL PRODUCTS ON THE WEIGHT AND RADIOIODINE UPTAKE OF THE THYROID GLAND IN THE RAT. William L. Money, Lorraine Kirschner, Leon Kraintz, Priscilla Merrill, and Rulon W. Rawson. J. Clin. Endocrinol. 10, 1282-95(1950) Oct.

Because of discrepancies in the published literature, the role the adrenal gland and gonads play in normal thyroid physiology has been further investigated. A procedure for testing compounds by evaluating their relative effects on change in thyroid weight and thyroid uptake of I^{131} has been developed, and the results for testosterone propionate, progesterone, pregnenolone, estrone, estradiol benzoate, ACTH, cortisone, and epinephrine are presented.

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EVALUATION OF RADIOIODINE TEST FOR THYROID FUNCTION. Henry L. Jaffe and Richard E. Ottoman. J. Am. Med. Assoc. 143, 515-19(1950) June 10.

The basal metabolism rate, protein-bound blood iodine level, and radioactive iodine (I^{131}) uptake by the thyroid have been determined in 152 persons with some thyroid function alteration. The study of the radioiodine uptake in man is a safe and accurate diagnostic test for hyperthyroidism. The basal metabolism test and the protein-bound blood iodine determination are not routinely necessary unless the results of the radioiodine uptake study are borderline (30 to 35%) or out of proportion to the clinical picture. The blood iodine level is more reliable than the basal metabolic rate but less reliable than the radioactive iodine uptake study. According to this study, the radioiodine tracer test is 95% accurate; the blood iodine test is 80% accurate, and the basal metabolism test is 67% accurate. No "false high" radioiodine uptakes were found in patients without other evidence of thyrotoxicosis. "False normal" radioiodine uptakes occur in patients who have recently ingested propylthiouracil, strong iodine solution, or thyroid preparations. In acute thyroiditis the uptake will be low, in spite of an elevation in the organic blood iodine; in hypothyroid children with iodine-hungry hyperplastic glands the uptake may be elevated. As the radioiodine-uptake study becomes available to more and more hospitals, its use should be encouraged. It is technically simple and easy to perform as far as the patient is concerned, even with infants and children. Radioiodine uptake studies are advised, when available, for all patients with clinically suspected hyperthyroidism, regardless of the type of treatment to be used (surgical intervention or thiouracil or radioiodine therapy).

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EXCRETION OF ADMINISTERED RADIOCALCIUM FOLLOWING THYROPARATHYROIDECTOMY, OR BILATERAL NEPHRECTOMY, AND THE INJECTION OF PARATHYROID EXTRACT. W. R. Tweedy, M. V. L'Heureux, and E. M. Zorn. Endocrinology 47, 219-27(1950) Oct.

The urinary and fecal excretion of administered radiocalcium, Ca^{45}, by rats during an 18-hr period was determined at intervals of 1 to 40 days after thyroparathyroidectomy. On an adequate diet, containing approximately 1.18% of calcium and 0.98% of phosphorus, the urinary excretion of administered Ca^{45} was unchanged but the fecal excretion was diminished and remained below the control level for several days. Administered Ca^{45} appeared to accumulate in the kidneys of thyroparathyroidectomized rats, injected with parathyroid extract, prior to the elevation of the serum calcium level, but the fractions of the Ca^{45} excreted in the urine and feces were not increased. Normal rats injected with toxic doses of parathyroid extract showed an increased urinary excretion of Ca^{45} concomitant with a decreased fecal excretion. Bilaterally nephrectomized rats excreted smaller amounts of Ca^{45} than their normal controls. The injection of parathyroid extract in nephrectomized rats did not increase the fecal excretion of Ca^{45}. (auth)

335

GLUCOSE SPACE OF THE BODY. Arne N. Wick, Douglas R. Drury, and Eaton M. Mackay. Am. J. Physiol. 163, 224-8 (1950) Nov. 1.

The glucose space of the rabbit has been measured by the injection of small quantities of C^{14}-labeled radioactive glucose. Dilution of the injected glucose is complete in 20 min, and no further dilution takes place in 3 hr or more. Two independent methods of calculation, one based on the concentration of radioactive material in the plasma after mixing and the other making use of the injected glucose specific activity, gave almost identical results. The figures for the glucose space are the same as those for the thiocyanate space of the rabbit and little more than half of those reported for the galactose space of the dog. As a percentage of the body weight the glucose space after evisceration averaged 26%, after evisceration and nephrectomy, 27%, and in the intact animal, 31% of body weight. (auth)

336

IDENTIFICATION OF γ-AMINOBUTYRIC ACID IN BRAIN BY THE ISOTOPE DERIVATIVE METHOD. Sidney Udenfriend. J. Biol. Chem. 187, 65-9(1950) Nov.

The isotope derivative indicator procedure as applied to the quantitative determination of amino acids consists in converting the amino acids in a mixture to the I^{131}-labeled p-iodophenylsulfonyl (pipsyl) chloride derivatives, adding a measured amount of the S^{35}-labeled pipsyl derivative of the amino acid to be determined, subjecting the mixture to paper chromatography, and measuring the I^{131}/S^{35} ratio in each transverse radioactive band. A constant ratio identifies the I^{131}-labeled compound. This procedure has been used in identifying γ-aminobutyric acid in extracts of mouse brain, and has been shown to provide rigorous identification at the microgram level.

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MEASUREMENT OF THE BLOOD VOLUME BY MEANS OF BLOOD CORPUSCLES LABELED WITH P^{32}. Hans H. Bohr. Kgl. Danske Videnskab. Selskab, Biol. Medd. 28, No. 1, 1-17 (1950)

Theoretical considerations in connection with the determination of the blood volume by means of erythrocytes labeled with P^{32} are put forward, and their correctness is tested by measurement of the rate of interchange between plasma and blood corpuscles in experiments carried out in vitro. The results obtained permit a satisfactory explanation of the data obtained by various experimenters. The rate of loss of P^{32} by the activated corpuscles was found to increase markedly in blood incubated at 37° for more than 5 hr. Addition of glucose reduced the rate of loss of P^{32} by the corpuscles. The most favorable way of obtaining labeled corpuscles is discussed. 15 references. (auth)

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THE MEASUREMENT OF EXCHANGEABLE POTASSIUM IN MAN BY ISOTOPE DILUTION. Leslie Corsa, Jr., John M. Olney, Jr., Richard W. Steenburg, Margaret R. Ball, and Francis D. Moore. J. Clin. Invest. 29, 1280-95(1950)Oct.

The principle of isotope dilution is applied to measurement of the quantity of potassium in a living man which will exchange with administered K^{42}. The method utilizes urine specific activity as representative of over-all body exchange. Potassium exchange in the human is shown to be similar to that of other animals, rapid in most viscera, fairly rapid in muscle, but slow enough in red cells, brain, and, probably, bone that complete exchange is not accomplished in 40 hr. Isotope effects, toxicity, and sources of error are discussed. It is concluded that this method offers the investigator a practicable new device for the study of electrolyte changes in the living human.

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THE MEASUREMENT OF TOTAL BODY WATER IN THE HUMAN SUBJECT BY DEUTERIUM OXIDE DILUTION, WITH A CONSIDERATION OF THE DYNAMICS OF DEUTERIUM DISTRIBUTION. Paul R. Schloerb, Bent J. Friis-Hansen, Isidore S. Edelman, A. K. Solomon, and Francis D. Moore. J. Clin. Invest. 29, 1296-1310(1950) Oct.

Analysis of the serum deuterium oxide concentration by a double vacuum distillation and densimetric determination with the falling drop apparatus proved to be a precise analytic procedure and checked well with duplicate determinations done on the mass spectrometer. Total body water figures have a precision of ±800 cc or ±2% of total body water in a normal adult. Of the physical indices studied, total body water was correlated most closely with surface area and oxygen consumption. After intravenous injection of D_2O, equilibrium in body water as measured by venous blood serum was attained within 2 hr. The dynamics of deuterium equilibrium, involving intravenous, oral, and subcutaneous administration and a study of the early arteriovenous deuterium differences, is described. The half-time for heavy water in the adult human body is 9.3 ± 1.5 days. Preliminary results from the study of deuterium oxide equilibration by analysis of arterial blood samples soon after intravenous injection of heavy water consistently revealed a double exponential curve.

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P^{32} AUTORADIOGRAPHS OF MOUSE TESTIS. PRELIMINARY OBSERVATIONS OF THE TIMING OF SPERMATOGENIC STAGES. Alma Howard and S. R. Pelc. Brit. J. Radiology 23, 634-41(1950) Nov.

Testis material from mice killed 2, 5, 9, and 12 days after injection of 200 μc of P^{32} was autoradiographed by the stripping-film technique and examined cytologically. Cells at different stages of spermatogenesis were found to take up P^{32} differently. Some preliminary estimates as to the time taken by various stages of spermatogenesis are (a) from spermatogonial metaphase to early meiotic prophase, between 3 and 9 days; (b) from diakinesis to second metaphase, 4 days or less; (c) from diakinesis to immature sperm, 7 days or more; (d) from spermatogonial metaphase to immature sperm, more than 10 days. Leydig cells were observed to show a strong uptake of P^{32} within the first 2 days. Some possible explanations for this observation are put forward. (auth)

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PHOTOSYNTHESIS AND RESPIRATION: A REINTERPRETATION OF RECENT WORK WITH RADIOACTIVE CARBON. F. C. Steward and J. F. Thompson. Nature 166, 593-6 (1950) Oct.

Concerning the old, but still challenging, problem of the first product of photosynthesis and the subsequent path toward sugar, two different groups of workers have recently reached different conclusions. In each case, the laboratories in question have utilized radioactive carbon dioxide, and each case is supported by impressive evidence. The problem now becomes one of interpretation. Analysis attempts to place some of this work in a different perspective, and this may afford some aid toward resolving the discrepancy between the two schools. The lesson to be learned is, however, that photosynthesis is not merely an isolated chemical problem. As it proceeds in vivo it occurs in a milieu obliged to carry out numerous other metabolic processes which are consistent with the maintenance and the growth of cells. This thesis is that certain interpretations obtained have ignored the concomitant processes of protein synthesis and breakdown, and in so doing have drawn conclusions which are physiologically improbable.

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A STUDY OF THE ABSORPTION CHARACTERISTICS OF IODINE^{131} LABELED IODINATED CASEIN IN SOME MAMMALS. D. J. Campbell, F. N. Andrews, and J. E. Christian. Endocrinology 47, 242-50(1950) Oct.

Iodocasein labeled with I^{131} has been synthesized and administered to rats and sheep in order to study the metabolites appearing in the blood and plasma and in the milk of lactating ewes. Particular emphasis was placed on the determination of the I^{131} distribution between the thyroxine and diiodotyrosine fractions because of the interest in these compounds in the study of the nature of the circulating thyroid hormone. Metabolites of iodocasein may also be responsible for an adverse growth effect in suckling lambs.

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SULFUR METABOLISM OF PLANTS. EFFECT OF SULFUR DIOXIDE ON VEGETATION. Moyer D. Thomas, Russel H.

Hendricks, and George R. Hill. Ind. Eng. Chem. 42, 2223-7 (1950) Nov. (See also NSA 4-5382.)

Sulfur is an essential constituent of the plant proteins. Excess sulfur above that needed for organic compounds is present as sulfate. Organic sulfur values have narrow limits in the different species of plants but sulfate concentrations vary over a wide range depending on the sulfur supply to the plant. Sulfur fractionation and distribution have been studied by means of radiosulfur and paper chromatography. Cystine and methionine account for a large part of organic sulfur in alfafa leaves. Nitrogen and sulfur nutrition are closely related. Effect of sulfur dioxide absorption in sublethal amounts, mechanism of sulfur dioxide injury, role of environmental factors in controlling absorption of gas by the plants, and effect of leaf destruction on yield are discussed. (auth)

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THE UPTAKE AND DISTRIBUTION OF RADIOACTIVE PHOSPHORUS IN CHICKEN EGGS CONTAINING A RAPIDLY GROWING MAMMARY TUMOR OF A C3H MOUSE. Irving Galinsky. Cancer Research 10, 642-3(1950) Oct.

A C3H mammary carcinoma was grown in fertile chicken eggs by the yolk sac injection technique. Radioactive phosphorus in a 1% Na_2HPO_4 solution was injected between the chorio-allantoic membrane and the egg shell 8 days after tumor inoculation. The P^{32} was taken up by the blood stream and distributed throughout the egg. At 48 hr most of the P^{32} was found in the allantoic fluid. The tumor took up more P^{32} than either the chick embryo brain or liver. The chick embryo skeleton accumulated P^{32} more rapidly than did the mouse tumor and at 96 hr after injection contained about 5 times as much. (auth)

CHEMISTRY

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Argonne National Laboratory
THE TETRAVALENT AND PENTAVALENT STATES OF PROTACTINIUM. Robert Elson, Sherman Fried, Phillip Sellers, and W. H. Zachariasen. [nd.] Decl. Oct. 23, 1950. 3p. (AECD-2989; ANL-WMM-696)

Two tetravalent compounds of protactinium in the anhydrous condition and one pentavalent compound have been prepared. The dioxide, PaO_2, a black solid, was prepared during an attempt to reduce a chloride with zinc at 600°C. The tetrachloride, $PaCl_4$, a yellow-green solid, volatile in vacuum at 400°C, was prepared by action of hydrogen on the white volatile chloride ($PaCl_5$?) at 800°C. The formulas of both compounds were established by analysis of their x-ray diffraction patterns. The tetrachloride has the tetragonal UCl_4-type structure. The unit cell dimensions are a_1 = 8.377 ± 0.004 A, a_3 = 7.482 ± 0.004 A. The dioxide has the fluorite structure and is thus isostructural with the dioxides of the other 5f-elements from thorium to americium. The unit cell constant is a = 5.505 ± 0.001 A. The cubic oxide phase extends over the entire range from PaO_2 to Pa_2O_5, the unit cell constant decreasing with increasing oxygen content to a value of a = 5.416 ± 0.001 A at Pa_2O_5. The cubic form of Pa_2O_5 was obtained as a white solid by heating the dioxide to 1100°C in oxygen. The oxide obtained by heating the hydrated oxide precipitated from solution is cubic with a unit cell constant of 5.46 ± 0.01 A. Its approximate composition is thus $PaO_{2.25}$ and not Pa_2O_5 as has previously been reported. A second form of Pa_2O_5 was obtained as a white solid in the course of an attempt to prepare the fluoride by action of bromine pentafluoride on $PaO_{2.25}$. This form of Pa_2O_5 is orthorhombic and isostructural with U_2O_5, Ta_2O_5, and Nb_2O_5. It is interesting to note that the preparation with bromine pentafluoride gave evidence of a volatile fluoride or oxyfluoride since the oxide obtained resulted from material volatilized out of the original sample. Attempts to prepare the tetravalent bromide and iodide of protactinium by methods analogous to those used for the preparations of the corresponding compounds of the other heavy elements have yielded compounds whose x-ray diffraction patterns have not yet been interpreted. An attempt to prepare the compound PaF_4 by action of a mixture of hydrogen fluoride and hydrogen on the oxide at 600°C resulted in the loss of the protactinium presumably by volatilization as fluoride or oxyfluoride.

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Columbia University and Brookhaven National Laboratory
THE EXCHANGE REACTION BETWEEN THE TWO OXIDATION STATES OF THALLIUM IN SOLUTION. G. Harbottle and R. W. Dodson. [nd.] 52p. (AECU-475)

An abstract of this report was indexed as report AECU-475 and appeared in its entirety in NSA as abstract 3-1865.

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Washington University (St. Louis)
AN ISOMERIC BENZYLIDENEGUANOSINE. David Lipkin and George C. McElheny. [nd.] 3p. (AECU-1003)

Benzylideneguanosine has been prepared from anhydrous yeast nucleic acid guanosine by the method of Michelson and Todd (J. Chem. Soc. 1949, 2476) and recrystallized from aqueous Cellosolve and 70% ethanol. The product was found to have the same melting point reported in the literature but a different specific rotation, indicating the existence of isomers of benzylideneguanosine. The following properties of the product were found: m.p. = 301 to 302°C (decomp.): $[\alpha]_D^{25} = -73.2°$ in dimethylformamide, c = 1.413; $[\alpha]_D^{25} = -72.5°$ in pyridine, c = 0.588; $[\alpha]_D^{25} = -79.8°$ in 0.1N NaOH, c = 0.602; calcd. for $C_{17}H_{17}O_5N_5$: C, 54.98; H, 4.62; N, 18.86%, found: C, 54.94; H, 4.52; N, 18.91%.

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Iowa State College
A POLAROGRAPHIC INVESTIGATION OF IRON-SULFOSALICYLATE COMPLEX IONS. Charles V. Banks and James H. Patterson. Oct. 6, 1950. 12p. (ISC-124; Contribution No. 105)

The yellow complex ion formed by iron salts with sulfosalicylate ions in neutral and alkaline solutions was studied polarographically by the half-wave potential method. It was found to contain three triply ionized sulfosalicylate ions for each ferric ion, and had a molar instability constant of approximately 10^{-42} at ionic strength 1. No evidence was found for complex ion formation between ferrous iron and sulfosalicylate ions. The second ionization constant of sulfosalicylic acid was determined spectrophotometrically to be 3.23×10^{-3} at 25°C and ionic strength 0.1. (auth)

ANALYTICAL PROCEDURES

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Argonne National Laboratory
THE DETERMINATION OF TRITIUM AND CARBON-14 IN ORGANIC COMPOUNDS. K. E. Wilzbach and Alexander VanDyken. Oct. 18, 1950. 4p. (AECD-2998; ANL-WMM-708)

Procedures have been developed for the assay of tracer quantities of tritium and C^{14} in organic compounds. The method used involves dry combustion on a semimicro scale of the compound over copper oxide, isolation of the H_2O and CO_2 by fractional condensation in vacuum, and reduction of the former to H_2 by zinc at 400°C. Chemical analyses, obtained by manometric measurement of the CO_2 and H_2, are comparable to those obtained by the usual gravimetric procedures. Radiochemical results are obtained by transferring the CO_2 or H_2 to a stainless steel ionization chamber of 250-cc capacity, diluting to a desired pressure (usually atmospheric), and measuring the ion current at saturation voltage with a dynamic condenser electrometer. The method is capable of detecting activities as low as 2×10^{-10} curie per gram of carbon and 7.5×10^{-9} curie of tritium per gram of hydrogen. Over-all results are reproducible to better than 1%.

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Brookhaven National Laboratory
OXYGEN AND NITROGEN ISOTOPE EFFECTS IN THE DECOMPOSITION OF AMMONIUM NITRATE. Lewis Friedman and Jacob Bigeleisen. [nd.] 20p. (AECU-901)

An abstract of this report was indexed as report AECU-901 and appeared in its entirety in NSA as abstract 4-5636.

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Brookhaven National Laboratory
SPECTROPHOTOMETRIC DETERMINATION OF CERIUM(IV). A. I. Medalia and B. J. Byrne. [nd.] 16p. (AECU-973)

Cerium(IV) shows an absorption maximum at approximately 320 mμ. Spectrophotometric determination at this wavelength is more than ten times as sensitive as with a blue filter in the visible. In the determination of cerium by oxidation with persulfate, it is important not to take too large an amount of persulfate, or of ammonium ion, because both residual persulfate, and nitrate ion formed by oxidation of ammonium ion, absorb appreciably at 320 mμ. Interference of several elements has been studied. (auth)

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Iowa State College
THE POLAROGRAPHIC DETERMINATION OF SMALL AMOUNTS OF CHROMIUM IN CALCIUM. Doris V. Stage and Charles V. Banks. Apr. 24, 1950. 6p. (ISC-108)

A polarographic method for the determination of small amounts of chromium in calcium metal is proposed. The diffusion current of the first chromium wave, occurring at −1.0 volt versus the saturated calomel electrode in 1M calcium chloride, was found to be directly proportional to the concentration. Factors affecting the diffusion current are discussed, and optimum conditions for the determination are described. (auth)

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Iowa State College
1,2-CYCLOHEPTANEDIONEDIOXIME AS A MICRO-GRAVIMETRIC REAGENT FOR NICKEL. Raymond C. Ferguson, Roger C. Voter, and Charles V. Banks. Aug. 19, 1950. 4p. (ISC-120; Contribution No. 121)

Heptoxime (1,2-cycloheptanedionedioxime), previously reported as a water-soluble gravimetric reagent for nickel, has been applied successfully to the microgravimetric determination of this ion. The procedure, modified from the macrodetermination, consists of precipitating nickel heptoxime in a microfilter beaker and weighing the precipitate after drying at 110 to 120°C. The commonly encountered cations and metallic ions do not interfere or may be masked by complexing agents. The method has been tested on standard nickel solutions and standard steel samples. (auth)

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Iowa State College
SPECTROPHOTOMETRIC DETERMINATION OF NICKEL USING 1,2-CYCLOHEPTANEDIONEDIOXIME (HEPTOXIME). Raymond C. Ferguson and Charles V. Banks. [nd.] 6p. (ISC-126; Contribution No. 129)

Heptoxime (1,2-cycloheptanedionedioxime) reacts with nickel in the presence of oxidizing agents in strongly basic solutions to produce reddish-brown complexes quite similar to those produced by 1,2-cyclohexamedionedioxime (nioxime) and dimethylglyoxime. Absorption spectra of a solution of nickel (15.4 γ/ml), bromine water, concentrated NH_4OH, and heptoxime were taken at intervals up to 6 hr after mixing. There was negligible change in the spectrum, which was nearly identical to those obtained from the dimethylglyoxime and nioxime complexes, during the first hour. Molar absorbency indexes, a_M, were calculated from curves obtained within 10 to 15 min after mixing. For heptoxime, a_M = 15,300 at the 443-mμ maximum and 6380 at the 531-mμ maximum. Heptoxime is thus a more sensitive reagent for nickel than either dimethylglyoxime or nioxime.

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New Brunswick Laboratory
THE DETERMINATION OF NICKEL IN ZIRCONIUM WITH DIMETHYLGLYOXIME. R. H. Beaumont, Jr., and G. J. Petretic. Aug. 15, 1950. 8p. (NYO-2011)

A colorimetric method is presented for the determination of μg quantities of Ni in Zr metal with dimethylglyoxime. The Zr metal is dissolved in dilute HF. Citric acid is added to complex the Zr. Nickel is oxidized with bromine water. A large excess of ammonium hydroxide is added. The solution is cooled below room temperature, and dimethylglyoxime is added. After approximately 15 min, the optical density of the solution is measured at 540 mμ. Interferences are negligible. Results are given and are shown to be comparable to those obtained polarographically. The color is stable for at least 3 hr, but results are better if the optical density is measured after a definite length of time. (auth)

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Chemical Research Laboratory, Teddington
CHEMICAL METHODS FOR THE ESTIMATION OF THORIUM IN MINERAL PRODUCTS; TECHNICAL REPORT CRL-AE-2 TO ACAE(M) CHEMICAL PANEL AND DAE ANALYTICAL PANEL. F. H. Burstall and W. Ryan. Apr. 20, 1950. 6p. (BR-744)

Methods are detailed for the estimation of thorium, with special reference to monazite sand, for a Bureau of Standards process and for a hexamine process. Notes on the concentration of thorium as oxalates with a conversion to nitrates, the concentration of thoria from rare earths, and the preparation of thorium sulfate $Th(SO_4)_2.8H_2O$ (approx) are included.

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Chemical Research Laboratory, Teddington
CHEMICAL METHODS FOR THE ESTIMATION OF URANIUM IN MINERAL PRODUCTS; TECHNICAL REPORT CRL-AE-1 TO ACAE(M) CHEMICAL PANEL AND DAE ANALYTICAL PANEL. F. H. Burstall and W. Ryan. Apr. 10, 1950. 7p. (BR-743)

Method I. Procedures for getting the ore into solution and extractions with cupferron and chloroform are described. A method for volumetric estimation is indicated based on an H_3PO_4 solution titrated with ceric sulfate. Method II. The procedures are similar to the previous method but based on extraction with ether. A method for volumetric estimation with low-grade ore, a method for calorimetric estimation, methods for fusion, and directions for the preparation of reagents are included.

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Imperial Chemical Industries, Ltd., Northwich
DETERMINATION OF THORIUM IN URANIUM COMPOUNDS; NOTE ON THE USE OF THE POLAROGRAPH IN THE ANALYTICAL EXAMINATION OF THORIUM m-NITROBENZOATE PRECIPITATES. J. Haslam and L. H. Cross. May 16, 1944. 4p. (BR-432A)

The Williams method for the determination of thorium in uranium compounds is based on a preliminary ether extraction of the uranium nitrate, followed by precipitation of the thorium in the unextracted portion as fluoride, and conversion of the fluoride to thorium m-nitrobenzoate. This nitrobenzoate is dissolved in acid, the acid solution is reduced with titanous salt, and the resulting m-aminobenzoic acid is diazotized and coupled with alkaline β-naphthol solution to yield an azo dyestuff, which is determined colorimetrically. The present report indicates that the lengthy reduction and diazotization procedure may be avoided by decomposition of the thorium nitrobenzoate precipitate with sodium hydroxide solution and polarographic examination of the resulting sodium m-nitrobenzoate solution.

359

North American Aviation, Inc.
THE PERCHLORIC-FORMIC ACID METHOD FOR GOLD. Louis Silverman. Oct. 20, 1950. 9p. (NAA-SR-101)

A procedure is described for the gravimetric determination of gold, based on the use of perchloric and formic acids, which permits more rapid analysis than other gravimetric methods. Interfering elements are listed, and necessary alternate steps are outlined. The procedure is illustrated by data from the analysis of gold copper alloys and of gold potassium cyanide. (auth)

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Chemical Research Laboratory, Teddington
A RAPID SEMIMICRO PROCEDURE FOR THE DETERMINATION OF URANIUM IN MINERALS AND ORES BY EXTRACTION METHODS. G. H. Smith and A. F. Williams. Jan. 1950. 10p. (CRL-AE-46)

A semimicro procedure is described for the determination of uranium in minerals, ores, and other products with particular application to materials containing 0.02 to 1.5% U_3O_8. In this method, 0.05 to 0.10 g of sample is fused with potassium hydroxide, and the melt is treated with nitric acid, evaporated, and extracted with ether containing 5% nitric acid. The solvent extract is passed through a small column containing cellulose and alumina, and the uranium in the eluent is determined by colorimetric or polarographic procedures. The method is rapid, reasonably accurate (±6%), and well suited to routine determinations on a variety of ores.

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Bureau of Mines
TRANSMISSION CHARACTERISTICS IN THE VISIBLE SPECTRAL REGION OF THE QUINALIZARIN AND BERYLLIUM-QUINALIZARIN COMPLEX IN N/4 SODIUM HYDROXIDE SOLUTION. Graham W. Marks and H. Tracy Hall. Oct. 1950. 10p. (BMI-RI-4741)

A chemical method of analysis for beryllium has been developed in which quinalizarin (1,2,5,8-tetrahydroxyanthraquinone) in 0.25N NaOH is used as a colorimetric titration reagent. This solution has a reddish-purple color, whereas the solution containing equivalent amounts of beryllium and the dye is rather blue. Standard quinalizarin solution is added to the unknown beryllium sample and to two standard beryllium samples of different but known concentrations. Adjustments in concentrations of BeO in the two known and of quinalizarin in all three are made until the red-violet shade of the unknown is halfway between that of the two knowns. The amount of BeO in the unknown is calculated from the known BeO content of the solutions between which it lies. To distinguish the slight differences in shade of these solutions, especially when the concentration is greater than 0.1 mg of BeO, a study was made of the transmission characteristics of quinalizarin in 0.25N NaOH and of the corresponding beryllium complex to determine what filter would give the most constrast. A simple procedure for using a Baird grating

spectrograph for the determination of transmission characteristics in the visible region is described.

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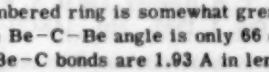
THE USE OF TANNIN IN THE ESTIMATION OF ZIRCONIUM AND ITS SEPARATION FROM THORIUM. A. Purushottam and Bh. S. V. Raghava Rao. Analyst 75, 555-7(1950) Oct.

Zirconium is quantitatively precipitated by tannin from a chloride solution up to 0.15N in hydrochloric acid. By double precipitation at this acidity it can be quantitatively separated from thorium. (auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

363

Iowa State College
THE STRUCTURE OF DIMETHYLBERYLLIUM. A. I. Snow and R. E. Rundle. Oct. 17, 1950. 16p. (ISC-118; Contribution No. 119)

Dimethylberyllium is body-centered orthorhombic, with $a_0 = 6.13$, $b_0 = 11.53$, $c_0 = 4.18$ A, and a structure similar to SiS_2. In the  chains, the C–Be–C angle within the four-membered ring is somewhat greater than tetrahedral, and the Be–C–Be angle is only 66 deg. The electron deficient Be–C bonds are 1.93 A in length. This structure is in agreement with the rule that electron-deficient bonding results from the tendency of metals, with fewer valence electrons than low-energy orbitals, to use all their low-energy orbitals in forming bonds, even though combined with elements or groups containing no unshared pairs. (auth)

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General Electric Research Laboratory
CRYSTALLOGRAPHY AND INTERFACIAL FREE ENERGY OF NONCOHERENT TWIN BOUNDARIES IN COPPER. R. L. Fullman. Sept. 1950. 22p. (SO-2003; RL-419)

The crystallography and interfacial free energy of noncoherent twin boundaries in copper have been investigated. It is found that the noncoherent twin boundary is approximately parallel to a {113} plane of one crystal and to a {335} plane of the other. The ratio of the interfacial free energy of noncoherent twin boundaries to the average grain boundary free energy in copper is found to be 0.80 ± 0.015. Two measurements by a second method confirm the magnitude of this value. (auth)

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General Electric Research Laboratory
INTERFACIAL FREE ENERGY OF COHERENT TWIN BOUNDARIES IN COPPER — II. R. L. Fullman. Oct. 1950. 32p. (SO-2004; RL-420)

The ratio of the interfacial free energy of coherent twin boundaries to the average grain boundary free energy in copper has been determined by means of measurements of the dihedral angles at grooves developed by thermal etching in lead vapor. The value found for this ratio is 0.0257 ± 0.0022. (auth)

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General Electric Research Laboratory
FORMATION OF ANNEALING TWINS DURING GRAIN GROWTH. R. L. Fullman and J. C. Fisher. Oct. 1950. 32p. (SO-2005; RL-421)

It is proposed that annealing twins form during grain growth as a result of a decrease in the interfacial free energy of grain boundaries that would not be achieved in the absence of twinning. Experiments designed to permit detection of the changes in grain boundary free energy accompanying the formation of twins give results in agreement with this concept. The abundance of twins found in annealed copper depends on the texture in a manner that is consistent with the theory. (auth)

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General Electric Research Laboratory
ANNEALING TWINS IN ALUMINUM. R. L. Fullman. Sept. 1950. 22p. (SO-2006; RL-422)

The number of twin boundaries per grain in annealed aluminum sheet is about 0.10. The ratio of the interfacial free energy of twin boundaries to that of grain boundaries in aluminum is found to be 0.21 ± 0.05. The rarity of annealing twins in aluminum compared to other face-centered cubic metals is consistent with the relatively large interfacial free energy of its twin boundaries compared to that of its grain boundaries. (auth)

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General Electric Research Laboratory
GRAIN BOUNDARY AND SURFACE DIFFUSION. D. Turnbull. Oct. 1950. 31p. (SO-2009; RL-442)

In general the diffusion of a substance into a polycrystalline aggregate must be described in terms of three diffusion coefficients D_l, D_B, D_S characteristic of the lattice, grain boundaries, and free surface, respectively. The amounts of matter transported via grain boundaries and via the crystal lattice are calculated and compared for various conditions. It is shown that the absence of grain size effects in some diffusion measurements does not necessarily imply that $D_B \approx D_l$. On the basis of the existing evidence it is concluded that D_B, $D_S \gg D_l$ in self diffusion and in the diffusion of substitutional solute elements. (auth)

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Atomic Energy Research Establishment
SLIP AND POLYGONIZATION IN ALUMINUM. R. W. Cahn. Sept. 1950. 33p. (AERE-M/R-570; HD-389)

A method is described for making aluminum crystals of predetermined orientation from the melt. The development of slip lines during stretching of such crystals was studied in detail, with reference particularly to cross slip (localized slip on planes other than the octahedral plane subject to the maximum shear stress) and to deformation bands. Cross slip took place on several distinct planes, an octahedral one being the most common. The proportion of

cross slip increased with the deformation and with rising temperature of deformation. Deformation bands were found to be associated with uneven elongation of adjacent parts of a crystal; their orientation changed systematically with increasing deformation, being initially normal to the slip direction. They were also formed in bicrystals and polycrystals and during deformation at elevated temperatures, but not in bent crystals. Annealing at high temperatures caused progressive polygonization within the bands; new grains formed by recrystallization tended to advance preferentially along the bands. When a specimen with polygonized deformation bands was made to creep, there was viscous motion at the polygonization boundaries. Possible reasons for the occurrence of cross slip and deformation bands are discussed. 36 figures. (auth)

370

Atomic Energy Research Establishment
A TECHNIQUE FOR SINGLE CRYSTAL, NEUTRON DIFFRACTION ANALYSIS. R. D. Lowde. Oct. 1950. 8p. (AERE-G/R-577)

A technique of neutron-diffraction analysis is described which permits the use of small single crystals of volume about 1 mm^3 in conjunction with a pile of only moderate neutron flux. Theory and experiment confirm that the method leads to greater counting rates, and a greater ratio of significant count to background, than in current techniques. The relation between this method and others is discussed. The technique may be expected to extend the scope of neutron diffraction analysis to cover simple crystal structures with large disordered scattering. When very high flux piles become available, it appears that neutron-diffraction analysis may be conducted with techniques altogether similar to those of modern x-ray crystallography. (auth)

FLUORINE AND FLUORINE COMPOUNDS

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FLUORINATED DERIVATIVES OF PROPANE CONTAINING A $-CHF_2$ GROUP. H. W. Davis and A. M. Whaley. J. Am. Chem. Soc. 72, 4637-8(1950) Oct.

The hydrogen in a $-CHF_2$ group has been found to be more resistant to displacement by chlorine and attack by alkali than that in a $-CHCl_2$ group. Four new compounds, $CHCl_2CCl_2CHF_2$, $CCl_3CCl_2CHF_2$, $CFCl_2CCl_2CHF_2$, and $CF_2ClCCl_2CHF_2$ were prepared in the course of this investigation. (auth)

372

INORGANIC COMPOUNDS CONTAINING SULFUR AND FLUORINE. Henry C. Miller and J. F. Gall. Ind. Eng. Chem. 42, 2223-7(1950) Nov.

Although few inorganic compounds containing sulfur and fluorine have found practicable application, and in no case have they found large scale use, they have a wide range of properties and unusual combinations of characteristics. The preparation, physical characteristics, and chemical reactivity of inorganic sulfur-fluorine compounds are reviewed. 32 references. (auth)

373

Minnesota Mining and Manufacturing Co.
QUARTERLY PROGRESS REPORT NO. 1 (MAY TO JULY 1949). W. H. Pearlson. July 1949. 6p. (NP-1575)

The progress that has been made during this quarter on the polymerization of fluorinated compounds is briefly reported. Perfluoropropylene does not polymerize under conditions suitable for perfluoroethylene. Base-catalyzed polymerization has produced some tarry materials as yet unidentified. The substituted olefin $C_2F_7C(CH_3)=CH_2$ has also proved resistant to mild conditions. Vinyl perfluorobutyrate hydrolyzes in aqueous solution about 10,000 times more rapidly than ethyl acetate, making emulsion polymerization in water at ordinary temperatures difficult. Nonaqueous emulsions appear possible and are being investigated. Boiling points, densities, and indexes of refraction are given for some fluorinated monomers and monomer precursors.

LABORATORIES AND EQUIPMENT

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Oak Ridge National Laboratory
DECONTAMINATION AND CORROSION RESISTANCE PROPERTIES OF SELECTED LABORATORY SURFACES. C. D. Watson, T. H. Handley, and G. A. West. Aug. 29, 1950. Decl. Oct. 3, 1950. 35p. (AECD-2996; ORNL-732)

A selection of 50 materials has been compared as decontaminable surfaces applicable to radiochemical laboratories. The susceptibility of these materials to contamination with a fission product mixture, their subsequent ease of decontamination with various reagent washes, and resistance to common laboratory reagents are presented. A selection has been made of the best materials for each of the following applications: uncoated reference materials (for control purposes), baked interior panels, protective plastic coatings (air dried), laboratory bench top materials, floor tiles, and disposable (strippable) plastic films.

SEPARATION PROCEDURES

375

Oak Ridge National Laboratory
THE RECOVERY OF Cs^{137} FROM ORNL RADIOCHEMICAL WASTE. A. T. Gresky. Oct. 12, 1950. 11p. (AECD-2999; ORNL-742)

A process has been demonstrated on a 1-liter scale for the recovery of Cs^{137} from alkaline radiochemical wastes. The process involves co-crystallization, or carrying, of cesium on potassium alum at a pH of 4.5. Yields of 95 to 100% have been obtained. It is recommended that the process be developed further as an initial step in the production of carrier-free tracer or as a method for removing Cs from waste solutions before storage. (auth)

376

University of California Radiation Laboratory
ANION EXCHANGE OF COMPLEX FLUO-IONS OF

ZIRCONIUM AND HAFNIUM. E. H. Huffman and R. C. Lilly. Aug. 23, 1950. 21p. (UCRL-878)

The elution of complex fluo-ions of Zr and Hf from an anion exchange resin (Amberlite IRA-400) with mixtures of HCl and HF has been studied in two different concentration ranges. Differences in the dependence of the distribution coefficient on both the Cl^- ion concentration and on the HF concentration have been noted for the two ranges, and some possible ionic equilibria are discussed in connection with the data.

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University of California Radiation Laboratory
CARRIER-FREE RADIOISOTOPES FROM CYCLOTRON TARGETS. XII. PREPARATION AND ISOLATION OF Be^7 FROM LITHIUM. Herman R. Haymond, Warren M. Garrison, and Joseph G. Hamilton. Sept. 20, 1950. 4p. (UCRL-920)

This report is reproduced here in its entirety.

The radionuclide Be^7, produced from lithium by the nuclear reaction $Li^7(p,n)Be^7$ (Seaborg and Perlman, Rev. Mod. Phys. 20, 585(1948)), using the 10-Mev proton beam of the 60-in. cyclotron, has been isolated without added isotopic carrier by a separation procedure based on the radiocolloidal (Hahn, Applied Radiochemistry, Ithaca, New York, Cornell University Press, 1936) properties of Be^7. Other radioisotopes produced concurrently by proton bombardment of lithium are short-lived and had decayed prior to the separation reported here. The principal radioactive by-product observed was 112-min F^{18} produced by proton bombardment of the small amount of oxygen present as lithium oxide on the target surface. Five grams of c.p. lithium metal (beryllium could not be detected by spectrographic analysis) was pressed onto a grooved water cooled copper plate and bombarded in vacuum for 120 μa-hr at an average beam intensity of 8 μa. The bombarded lithium was dissolved in 100 ml of water with the gradual addition of dilute HCl. The acid solution was filtered and adjusted to pH 9 with dilute NH_4OH (previous experiments had shown that between pH 2 and pH 9, the amount of Be^7 which could be removed by filtration increased with pH). This "solution" containing lithium hydroxide, ammonium hydroxide, and Be^7 presumably as a radiocolloid, was slowly drawn through a pyrex sintered-glass filter, the pore size of which was of the order of 5μ. More than 90% of the carrier-free Be^7 remained adsorbed on the glass filter disk (filtration through Whatman No. 40 removed only 30 to 50% of the Be^7). After washing the filter with 2 ml of water, which removed less than 5% of the activity, the Be^7 was quantitatively removed with 2 ml of 0.1N HCl. The resultant solution after neutralization was used as a tracer for biological studies. Approximately 30 min were required for the separation, which had an over-all yield of approximately 90%. The Be^7 was identified by the 52-day half life and 0.48-Mev γ ray previously reported (Segrè and Wiegand, Phys. Rev. 75, 39 (1949) and Rubin, Phys. Rev. 69, 134(1946)).

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University of California Radiation Laboratory
CARRIER-FREE RADIOISOTOPES FROM CYCLOTRON TARGETS. XIII. PREPARATION AND ISOLATION OF $Sc^{44,46,47,48}$ FROM TITANIUM. Jeanne D. Gile, Warren M. Garrison, and Joseph G. Hamilton. Sept. 20, 1950. 4p. (UCRL-921)

This report is reproduced here in its entirety.

The radioactive scandium (Seaborg and Perlman, Rev. Mod. Phys. 20, 585(1948)) was prepared by bombardment of natural titanium with 20-Mev deuterons in the 60-in. cyclotron at Crocker Laboratory. At this energy, radioscandium is produced by the nuclear reactions: $Ti^{46}(d,\alpha)Sc^{44}$, $Ti^{46}(d,2p)Sc^{46}$, $Ti^{47}(d,2p)Sc^{47}$, $Ti^{47}(d,\alpha n)Sc^{44}$, $Ti^{48}(d,\alpha)Sc^{46}$, $Ti^{48}(d,2p)Sc^{48}$, $Ti^{49}(d,\alpha)Sc^{47}$, $Ti^{49}(d,\alpha n)$ Sc^{46}, $Ti^{50}(d,\alpha n)Sc^{47}$, and $Ti^{50}(d,\alpha)Sc^{48}$; long-lived radiocalcium and radiovanadium are produced concurrently by the reactions: $Ti^{46}(d,\alpha p)Ca^{45}$, $Ti^{46}(d,2n)V^{48}$, $Ti^{48}(d,n)V^{48}$, $Ti^{47}(d,n)V^{48}$, and $Ti^{50}(d,2n)V^{49}$. In the procedure described here, the carrier-free radioscandium is separated as a radiocolloid (Hahn, Applied Radiochemistry, Ithaca, New York, Cornell University Press, 1936) from an ammonium hydroxide–hydrogen peroxide solution containing the target element and the concurrently produced radioisotopes of calcium and vanadium.

The titanium target, c.p. metal powder (scandium could not be detected by spectrographic analyses) supported on a copper target plate with 0.25 mil platinum foil, was bombarded for 100 μa-hr at an average beam intensity of 20 μa. After aging for 24 hr, the bombarded titanium metal powder (approximately 1 g) was dissolved in 40 ml of 18N sulfuric acid containing 5% 16N nitric acid. A small amount of undissolved inactive material was removed by centrifugation. The supernatant was slowly added to 200 ml of 8N ammonium hydroxide containing 15 ml of 30% hydrogen peroxide to give a clear yellow "solution" of the following composition: (1) titanium as the soluble pertitanate, (2) radiocalcium, (3) radiovanadium as pervanadate, (4) radioscandium as radiocolloidal aggregates (Kurbatov and Kurbatov, J. Chem. Phys. 13, 208(1945)). This "solution" was then passed through two consecutive Whatman No. 42 filter papers which retained more than 95% of the scandium activity as adsorbed radiocolloid. After washing with 10 ml of water, the scandium activity was quantitatively removed in 10 ml of 1N hydrochloric acid which, after neutralization with the ammonium hydroxide–hydrogen peroxide solution, was again passed through filter paper. Three such cycles gave a hydrochloric acid solution of carrier-free radioscandium containing less than 2 γ of titanium. In a chemical separation performed on this final fraction using added scandium, calcium, titanium, and vanadium carriers, more than 98% of the activity was recovered in the scandium fraction.

The decay was followed for 45 days and showed initially a composite 2.5-day half life corresponding to the shorter-lived scandium isotopes (2.2-day Sc^{44}, 3.4-day Sc^{47}, 44-hr Sc^{48}). Twenty-four hours after bombardment, absorption measurements in aluminum showed the 1.4-Mev β particle of 3.9-hr Sc^{44} which is produced (Walke, Phys. Rev. 57, 163(1940)) by isomeric transition from 2.2-day Sc^{44}. The γ radiation had a half-thickness of 11.0 g (sic) in lead. Thirty-six days after bombardment, the activity had an approximately 80-day half period; aluminum absorption measurements showed the 0.36- and 1.5-Mev β particles previously reported (Walke, Williams, and Evans, Proc. Roy. Soc. (London) A171, 360, (1939)) for 85-day Sc^{46}.

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ENGINEERING ASPECTS OF SEPARATION OF GASES. FRACTIONAL PERMEATION THROUGH MEMBRANES. Sol Weller and Waldo A. Steiner. Chem. Eng. Progress 46, 585-90(1950) Nov.

Many nonporus organic membranes show widely varying permeabilities toward different gases. This property can be made the basis of a process for the separation of appropriate gas mixtures. The theory has been developed for the fractionation of a binary gas mixture, and the theory has been checked in a small, laboratory, single stage unit operating on air at five atmospheres. Permeability coefficients toward a number of gases have been determined for a variety of commercial packaging films. Of the films tested, ethyl cellulose seems to be most suitable for the fractionation of air, and polystyrene most suitable for the separation of helium and hydrogen from gas mixtures. Since the films are not perfectly selective, in general it is necessary to employ a multistage recycle system to obtain gases of high purity, but the number of stages can be small in favorable cases. Application of the theory indicates that processes of potential commercial interest can be set up for separation of oxygen from air, of helium from natural gas, and of hydrogen from such gases as coke-oven gas, tail-gas from hydrogenation processes, and petroleum refinery gases. (auth)

380

MONOBED—SOMETHING NEW IN ION EXCHANGE FOR WATER TREATMENT. Power Eng. 54, No. 10, 94(1950) Oct.

A new development in the use of intimate mixtures of anion and cation exchangers in a single bed of resins is discussed. The exchanger is designed to completely deionize water in one pass through one unit. The use of ion exchange resins for water treatment, either alone or in combination with other methods of treatment, has been increasing rapidly during the past few years. Until recently it was necessary to use anion and cation exchangers in separate beds (that is, in separate containers), but now the development of new types of ion exchange resins permits various types to be mixed, each type performing its functions separately and yet being of such a nature that it can be regenerated separately and then re-mixed in the container.

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THE SEPARATION OF URANIUM. MINERAL TECHNIQUE DEVELOPED BY THE CHEMICAL RESEARCH LABORATORY. Chem. Age (London) 63, 648-50(1950) Nov.

Treatment of pitchblende and other refractory ores to obtain a solution for analysis, steps in a chemical method of separation based on the use of cupferron (ammonium nitrosophenyl hydroxylamine), the liquid-liquid solvent extraction method based on the quantitative extraction of uranium as uranyl nitrate by ether from aqueous solutions containing metal nitrates and free nitric acid, and a solvent extraction method in combination with a cellulose adsorbent are presented.

SYNTHESES

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Los Alamos Scientific Laboratory
MICRO SYNTHESES WITH TRACER ELEMENTS. XXII. THE SYNTHESIS OF TOLUENE LABELED WITH C^{14}. C. Wayne Bills and Anthony R. Ronzio. [nd.] 3p. (AECU-1007; LADC-880)

Toluene is the raw material in a large number of syntheses which are used for the preparation of compounds of biological and biochemical interest. For this reason toluene labeled with C^{14} was desired. A synthesis involving the labeling in the ring is laborious and time-consuming and gives low yields. Labeling at the methyl group was accordingly studied and is here reported. A 97.49% yield was obtained by the hydrogen reduction of benzyl alcohol.

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University of California Radiation Laboratory
THE SYNTHESIS OF LEUCINE AND SEVERAL BRANCHED-CHAIN FATTY ACIDS LABELED WITH CARBON-14 IN VARIOUS POSITIONS. H. Hauptmann, P. T. Adams, and B. M. Tolbert. Oct. 2, 1950. 13p. (UCRL-935)

The following compounds have been synthesized, labeled with C^{14}. The per cent yields, based on $C^{14}O^2$ used, are indicated in parentheses: sodium isobutyrate-1-C^{14} (97.5); sodium isovalerate-1-C^{14} (96.0); sodium isocaproate-1-C^{14} (95.5); sodium isocaproate-2-C^{14} (39); dl-leucine-1-C^{14} (43.5); and dl-leucine-2-C^{14} (29.3). A novel method was developed for the preparation of alcohols from intermediate-weight fatty acids and by this method isoamyl bromide-1-C^{14} was prepared in 73% yield based on sodium isovalerate-1-C^{14} used. (auth)

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THE SYNTHESIS OF OXALACETIC ACID-1-C^{14} AND OROTIC ACID-6-C^{14}. Charles Heidelberger and Robert B. Hurlbert. J. Am. Chem. Soc. 72, 4704-06(1950) Oct.

Oxalacetic acid-1-C^{14} (3-ketosuccinic acid-1-C^{14}) has been synthesized in good yield by pyrolysis of di-t-butyloxalacetate. Orotic acid-6-C^{14} (4-carboxyuracil-6-C^{14}) has been synthesized by extensive experimental modifications of a known synthesis.

TRACER APPLICATIONS

385

Los Alamos Scientific Laboratory
IODINE EXCHANGE REACTION. Jacob Kleinberg and James Sattizahn. Aug. 25, 1948. Decl. Oct. 26, 1950. 6p. (AECD-2995; LADC-866)

The exchange between iodine and unipositive iodine complexes of the type $[I_x^{py}]$ (where X is an organic acid anion) was studied in pyridine in the hope that additional light might be thrown on the nature of iodine-pyridine solutions. It is believed that complexes of this type react with pyridine to give an ion of the formula I_2^{py+}, which is essentially no different from the unipositive iodine ion which has been postulated to exist in iodine-pyridine solutions. The exchange was followed by 25-min I^{128}. Over a wide range of ratios of elementary iodine to unipositive iodine concentrations the former exchanges completely with the latter immediately after mixing. This exchange is independent of the nature of the organic anion in the complex.

386

C^{14} TRACER STUDIES IN THE SYNTHESIS OF MALONIC ACID-2-C^{14} AND DIETHYL MALONATE-2-C^{14}. Gus A Ropp. J. Am. Chem. Soc. 72, 4459-61(1950) Oct.

Potassium acetate-2-C^{14} has been converted in 76% yield to malonic acid-2-C^{14}. Ethyl acetate-2-C^{14} has been converted to diethyl malonate-2-C^{14} in 28.5% yield. Isotope dilution technique has been applied in studying the reactions involved. (auth)

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ON THE QUANTITATIVE CHROMATOGRAPHY OF THE RADIOACTIVE IODOAMINO ACIDS FROM LABELED THYROGLOBULIN. Jean Roche, Marian Jutisz, Serge Lissitzky, and Raymond Michel. Compt. rend. 231, 723-5 (1950) Oct. 9. (In French)

Thyroglobulin, labeled with I^{131}, has been hydrolyzed by $Ba(OH)_2$ and by trypsin, and the resulting radioactive hydrolyzates have been separated by paper chromatography. The distribution of activity on the chromatogram was measured with a G-M counter, giving a quantitative measurement of the inorganic iodine, monoiodotyrosine, diiodotyrosine, and thyroxine constituents. The relevance of the data to the metabolism of these compounds is briefly discussed.

URANIUM AND URANIUM COMPOUNDS

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Iowa State College
CHEMICAL PROPERTIES OF URANIUM HYDRIDE. James Curren Warf. Sept. 29, 1950. Decl. Nov. 6, 1950. 115p. (AECD-2997; ISC-50)

Pure uranium metal reacts rapidly with hydrogen at 250°C yielding a fine, black, pyrophoric powder, uranium hydride. Analysis shows a composition corresponding to the formula $UH_{2.97}$, but when the effects of impurities in the metal are taken into account, the formula of the compound formed is shown to be UH_3. Deuterium reacts with uranium analogously, forming UD_3. UH_3 is also formed by the action of steam, or of certain organic compounds, such as tetralin, on U. The physical and thermodynamic properties, x-ray analysis, and the chemical composition of UH_3 indicate that it is not a solid solution or interstitial compound, but a definite chemical compound. UH_3 may be thermally decomposed, yielding U metal powder which is exceedingly reactive. The general chemical properties of UH_3 are those of a strong reducing agent; it readily reacts with oxidizing agents of all types, as well as certain organic compounds. Some reactions in aqueous medium serve to prepare uranyl salts. UH_3 reacts with a wide variety of gases, yielding in certain cases U compounds difficult to prepare by other means. The techniques are simple, and are recommended preparative methods. Uranium metal or its hydride or certain compounds prepared from it are conveniently employed in the purification of several laboratory gases. By mixing the finely subdivided UH_3 with other substances also in the form of a fine powder, and heating, the hydride is decomposed, leaving U powder intimately mixed with the other substance, with which it may react on stronger heating. When carbon black in the proper proportion is used, uranium monocarbide is formed. Employing this technique with UF_4 caused its reduction to UF_3, previously unknown. The trifluoride is a black, cokelike solid. UH_3 readily forms "amalgams;" the evidence shows that the preparations are not true solutions in Hg or true amalgams, but suspensions. The amalgams vary in consistency from a fluid through a semisolid to a dark solid, as the UH_3 concentration is raised. Air, water, or H_2S serves to cause the hydride to precipitate from its amalgam. Several applications of UH_3 and the hydride reactions are: laboratory source of pure hydrogen or deuterium, preparation of powdered U, preparation of U compounds, isolation of intermetallic compounds of U, etching metallographic specimens, maintaining a given hydrogen or deuterium pressure, and analysis of metallic U for the free element. 67 references.

389

EXCHANGE REACTIONS OF URANIUM IONS IN SOLUTION. Elizabeth Rona. J. Am. Chem. Soc. 72, 4339-43 (1950) Oct. (See also MDDC-1730.)

Exchange reactions between U(IV) and U(VI) in hydrochloric acid solutions have been studied using U^{233} as a tracer. It was found that the reaction is of the first order with respect to the U(VI), second order with respect to the U(IV), and minus third order with respect to the hydrogen ion concentration. The rates of exchange did not change with added inert salt, with chloride ion concentration, nor with illumination. The apparent heat of activation was found to be 33,400 ± 800 cal/mole. A mechanism is proposed for the exchange. (auth)

390

Imperial Chemical Industries, Ltd., Billingham
THE REACTION BETWEEN WATER AND URANIUM HEXAFLUORIDE AND THE ACTION OF HEAT ON THE REACTION PRODUCT; TUBE ALLOYS — RESEARCH MEMORANDUM. H. E. Eduljee. Nov. 20, 1943. 7p. (BR-348A)

The reaction between UF_6 and water, irrespective of which reactant is in excess or in which phase the reaction is carried out, results in a complex between UO_2F_2, H_2O, and HF. The most probable formula for the complex is $8.5UO_2F_2 \cdot 3HF \cdot 11H_2O$. The complex decomposes at about 120°C to give UO_2F_2. When treated strongly, UO_2F_2 decomposes to U_3O_8, the fluorine being liberated by reaction with the containing vessel. X-ray photographs have been taken of the complex and of UO_2F_2. Further experiments are in progress to determine with more accuracy the composition of the $UO_2F_2 \cdot HF \cdot H_2O$ complex. (auth)

391

URANIUM. Clement J. Rodden and J. C. Warf. In Analytical Chemistry of the Manhattan Project, Clement J. Rodden, ed. New York, McGraw-Hill Book Company, Inc., 1950. (NNES Div. VIII, Vol.1, chap.1, p.3-159)

The methods of analysis used or developed by the Manhattan Project for separating and determining uranium are discussed extensively, and detailed procedures are given. Because of the unique importance of uranium and its compounds, a section on basic chemical properties of this element is included. Methods of dissolving uranium metal and its compounds are given. The most lengthy part of the chapter consists of detailed discussions of the gravimetric, volumetric, colorimetric, and fluorometric methods of determination and specific laboratory procedures. 37 figures. 459 references.

ENGINEERING

HEAT TRANSFER

392

Battelle Memorial Institute
AN APPROXIMATE CALCULATION OF THE TEMPERATURE DISTRIBUTION SURROUNDING COOLANT HOLES IN A HEAT-GENERATING SOLID. F. A. Fend, E. M. Baroody, and J. C. Bell. Oct. 25, 1950. 21p. (BMI-T-42)

The high temperatures found in nuclear reactors require a study of the resulting thermal stresses. As a preliminary to such a study, the temperature distribution is required and has been calculated for a uniformly heated solid cooled with uniformly spaced holes. The calculation methods used were a cylindrical approximation, use of circular harmonics, and a relaxation method. The circular harmonic method is well adapted to the solution of problems related to this one.

MATERIALS TESTING

393

North American Avaition, Inc.
SOME MECHANICAL PROPERTIES OF GRAPHITE AT ELEVATED TEMPERATURES. C. Malmstrom, R. Keen, and L. Green. Sept. 28, 1950. 35p. (NAA-SR-79)

The short-time tensile breaking strength of various grades of graphite was measured as a function of temperature from room temperature to the sublimation point. A characteristic, common to all the strength versus temperature curves, is that the strength approximately doubles in going from room temperature to about 2500°C and then decreases rapidly to zero near the sublimation point. The dependence of strength on room temperature, bulk density, and the density distribution within an original block is given for grade EBP graphite. The creep characteristics of grade ECA graphite under tensile stress at elevated temperatures were investigated. The testing temperature ranged from 2200 to 2900°C while the applied stress varied from 500 to 5500 psi. The range of "steady" creep rates measured extended from 3×10^{-5} to 2×10^{-4} in./in./sec. The activation energy and change in entropy defined by rate theory were calculated for the foregoing conditions. Low frequency dynamic measurements from 1000 to 2000°C showed an increase of the modulus with temperature. (auth)

PUMPS

394

University of California Radiation Laboratory
LIQUID SODIUM PUMP FOR THE PURIFICATION OF INERT ATMOSPHERES. Russell K. Edwards, Raleigh L. McKisson, and LeRoy A. Bromley. Sept. 28, 1950. 15p. (UCRL-687)

To maintain inert gas "dry-boxes" free of water, oxygen, and other oxidizing gases a liquid sodium pump and contracting tray have been developed. The dry-box gas is circulated over streams of molten sodium. With this apparatus it is easy to obtain and maintain an atmosphere whose reactivity is less than the best vacuums obtainable in which comparable manipulations may be accomplished. (auth)

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

395

Massachusetts Institute of Technology
SECOND INFORMAL MONTHLY REPORT [FOR THE PROJECT] ON DEVELOPMENT OF METAL—CERAMIC COMPOSITIONS SUITABLE FOR SERVICE AT ELEVATED TEMPERATURES [FOR THE PERIOD SEPTEMBER 1, TO SEPTEMBER 30, 1949]. W. D. Kingery, G. Economos, M. Humenik, Jr., and M. Berg. Sept. 1949. 3p. (NEPA-1170)

Design of the induction furnace and vacuum system for the sessile-drop method of determining wetting characteristics of metal-ceramic systems has been completed. External electrical control circuits have been completed, and component parts of the furnace system have been ordered. Standardization of a procedure for measuring wetting characteristics by the capillary-tube method is in progress. Methods of cutting and polishing samples are being investigated and the procedure for determining approximate contact angles and calculating the size capillary required has been standardized. (auth)

396

SINTERING REACTIONS IN MgO-TiC MIXTURES. H. F. G. Ueltz. J. Am. Ceram. Soc. 33, 340-4(1950) Nov.

Mixtures of MgO and TiC were sintered at four temperatures in an induction furnace using a helium atmosphere. X-ray patterns of the sinters were made and interpreted. Colors and appearance were noted and weight losses were determined for some samples. Observed changes in lattice dimensions are explained on the basis of the formation of titanium monoxide resulting from the partial reduction of magnesia by titanium carbide. 31 references. (auth)

GEOLOGY AND GEOPHYSICS

397

THE URANIUM CLOCK. Theodore H. Eaton, Jr. Frontiers, 11-12(1950) Oct.

It is shown that from a study of lead from four different sources of radioactive materials the age of the earth may be estimated. The earth may be about 3,350,000,000 years old.

METALS AND METALLURGY

398

NEPA Division
REPORT ON ZIRCONIUM NITRIDE. George D. Hall. Nov. 11, 1947. Decl. Dec. 3, 1948. 22p. (AECD-2971; NEPA-322)

Available data on chemical and physical properties and preparation of zirconium nitride have been assembled.

399

Iowa State College
THE PRODUCTION OF URANIUM AND THORIUM IN THE POWDER FORM. P. Chiotti and B. A. Rogers. [nd.]. 19p. (AECD-2974; ISC-31)

A description of a method of making powdered uranium and powdered thorium is presented. It may be done with ordinary laboratory equipment and in a short time. To prepare either powder, the starting metal is allowed to react with hydrogen to produce the hydride, which forms as a powder. The hydride is then decomposed under conditions such that no sintering occurs.

400

Argonne National Laboratory
RESISTANCE OF MATERIALS TO ATTACK BY LIQUID METALS. LeRoy R. Kelman, Walter D. Wilkinson, and Frank L. Yaggee. July 1950. 139p. (ANL-4417)

Tabular data and descriptive material are presented concerning the resistance of materials to attack by Na and Na-K alloys, Li, Hg, Pb, Bi, alloys of Pb and Bi, Mg, Cd, Tl, In, Ga, Al, Sn, Zn, and Sb.

401

Battelle Memorial Insititute
MEMORANDUM ON TITANIUM-GADOLINIUM AND TITANIUM-BORON ALLOYS TO HANFORD WORKS, GENERAL ELECTRIC CO., FROM BATTELLE MEMORIAL INSTITUTE. H. R. Ogden and R. I. Jaffee. May 12, 1950. 14p. (BMI-RIJ-1)

The data presented in this memorandum constitute the results of an investigation of the workability, mechanical properties, and microstructures of selected titanium-boron and titanium-gadolinium alloys. The compositions of the alloys selected for this investigation are given in the following tabulation.

Titanium-Boron	Titanium-Gadolinium
0.4B	0.6Gd
1.0B	5.2Gd
2.0B	
5.4B	

402

CASTING AND FORGING OF TITANIUM. J. Bartlett Sutton, Edwin A. Gee, and William B. DeLong. Metal Progress 58, 716-20(1950) Nov.

The operation of induction furnaces for melting titanium in graphite, the mechanical properties of the as-cast metal, and its forging characteristics are described. A commercially feasible method of casting titanium ingots up to 650 lb has been developed. Such ingots are homogeneous and contain as the primary impurity about 0.4 to 0.8% carbon. Complex alloys have been prepared without any apparent segregation. The structure of titanium ingots is sensitive to pouring temperature and rate of solidification. Porosity which occurs in some ingots is apparently eliminated by welding during forging. As-cast titanium shows appreciable ductility. Conversion curves relating various hardness scales for titanium are included.

403

California Institute of Technology Jet Propulsion Laboratory
DIFFUSION IN SOLIDS AS A RANDOM WALK PROCESS; PROGRESS REPORT NO. 4-63. S. Weinbaum. Apr. 12, 1948. 17p. (NP-1731)

Diffusion is of great importance in many problems encountered in the study of alloys. It is usually assumed that diffusion obeys Fick's equation. Diffusion may, however, also be regarded as a random walk process. When diffusion in solids is treated from this viewpoint, the results obtained are identical with the solution of Fick's equation with corresponding boundary conditions, and the diffusion constant may be expressed in terms of the interatomic distance and the rate at which the atom moves from one lattice position to another. It also becomes possible to investigate the question of anisotropy of diffusion in cubic crystals, with the result that in some cases such anisotropy can be shown to exist.

404

North American Aviation, Inc.
EVALUATION OF THERMAL PROPERTIES OF METALS; SURVEY OF METHOD AND THEORY. J. P. Dobbins. Aug. 25, 1948. 24p. (NA-48-913; CR-2106)

Practical means for obtaining quick quantitative estimates of heat capacities and conductivities for use in making preliminary design computations for aircraft turbojet exhaust systems are described. The means available for obtaining more accurate results for intermediate and final design are also outlined and referenced. 19 references. (auth)

405

GRAPHITE-ROD HAIRPIN-RESISTOR RADIATION FURNACE FOR HIGH TEMPERATURES. W. J. Kroll, W. W.

Stephens, and J. P. Walsted. J. Metals (N. Y.) 188, 1394-5 (1950) Nov.

The hairpin graphite-resistor radiation furnace is well-adapted for producing zirconium carbide from oxide at temperatures between 1800 and 2000°C with 100% recovery of the zirconium content. The power consumption in a rather small furnace is only about 5.7 kw-hr per pound of carbide produced. The voltage variation during the run is slight, so that cheap transformers can be used to supply the energy. The carbide obtained is of very good quality as far as its amenability to chlorination is concerned. The furnace described may be well-adapted for producing other high-melting carbides or borides, such as titanium carbide or boride. It cannot be recommended for reducing oxides that develop large quantities of CO_2, since this gas consumes the electrode at a rapid rate. (auth)

406

THE KINETICS OF THE REACTIONS OF BERYLLIUM WITH OXYGEN AND NITROGEN AND THE EFFECT OF OXIDE AND NITRIDE FILMS ON ITS VAPOR PRESSURE. Earl A. Gulbransen and Kenneth F. Andrew. J. Electrochem. Soc. 97, 383(1950) Nov.

A systematic study of the reaction of beryllium with oxygen was made over the temperature range 350 to 950°C. The experimental data may be fitted by the parabolic rate law except for the initial period of the reaction. A plot of log K/T vs 1/T (K = parabolic reaction rate constant, T = temperature) gives an energy of activation of 50,300 cal/mole. A comparison of this rate data with other metals and alloys shows that vacuum-treated beryllium has the smallest parabolic reaction rate constant at 900°C of any metal or alloy which has been studied. The reaction with nitrogen was studied over the temperature range 600 to 925°C. The data may be fitted by the parabolic rate law. A comparison with the oxygen reaction shows that the rate of reaction is somewhat smaller. A plot of log K/T vs 1/T gives an energy of activation of 75,000 cal/mole. No reaction was observed with hydrogen over the temperature range of 300 to 882°C. A study of the vapor pressure of beryllium and the influence of oxide and nitride films was made using the Langmuir method. Excellent agreement was found for the vacuum treated specimens with the recent results. Oxide films exert a strong effect in reducing the vapor pressure, the effect varying as the square root of the oxide thickness. A film of 99 micrograms per cm^2 lowers the vapor pressure 100-fold. 35 references. (auth)

407

THE KINETICS OF THE REACTIONS OF VANADIUM WITH OXYGEN AND NITROGEN. Earl A. Gulbransen and Kenneth F. Andrew. J. Electrochem. Soc. 97, 396-404(1950) Nov.

A study was made of the reaction of rolled vanadium sheet with oxygen over the temperature range 400 to 600°C using specimens weighing 0.1264 g and having a surface area of 1.4 cm^2. The data may be fitted to the parabolic rate law except for the initial period of the reaction. A plot of log K/T vs 1/T (K = the parabolic rate law constant, T = time) gives an energy of activation of 30,700 cal/mole. The oxidation of vanadium may be compared to the corresponding reactions on columbium and tantalum since the oxide is soluble at high temperatures and the extent of reaction is of the same order of magnitude. The reaction with nitrogen was studied over the temperature range 600° to 900°C. The rate of reaction with nitrogen was much less at a given temperature than the corresponding oxidation reaction. The nitrogen reaction is similar to that found for columbium and tantalum in the magnitude of the reaction and in the fact that the nitride film dissolves in the metal as fast as it is formed. The data may be fitted to the parabolic rate law. 35 references. (auth)

408

THE ELECTROLYTIC POLISHING OF ZIRCONIUM AND ITS APPLICATION TO A STUDY OF THE EFFECTS OF ABRASION UPON THE STRUCTURE OF THE METAL. P. A. Jacquet. Metallurgia 42, 268-70(1950) Oct.

The most satisfactory procedure found was the use of dilute perchloric acid electrolyte in an apparatus sold under the name "Disa-Electropol" (Metal Industry 75, 493(1949)). In this apparatus between 0.3 and 1 sq cm of specimen can be polished. The electrolyte which has only recently been introduced consists of 350 ml of 95% ethyl alcohol, 100 ml of perchloric acid (density 1.20) and 50 ml of 2-butoxyethanol ("Butyl Cellosolve"). A specimen with an area of 0.3 sq cm which had been ground on No. 1 and No. 0 emery papers polished in 10 to 20 sec, about 30 volts being used across the cell. The excellent quality of the micrographs obtained at several magnifications is illustrated. These show transverse sections of the bead of melted zirconium. The structure of this material is clearly heterogeneous, consisting of a solid solution and of small insoluble constituents which form a eutectic mass. The solid solution is itself not uniform, as is shown by certain of the lines that are faintly visible. The appearance suggests that the structure consists of dendrites of pure metal separated by areas containing impurities in solution and others precipitated in eutectic form. This is confirmed by examination of a specimen etched electrolytically.

409

METALLOGRAPHY OF ZIRCONIUM. H. P. Roth. Metal Progress 58, 709-11(1950) Nov.

The perchloric-acetic electrolytic method of etching is shown to be superior to mechanical polishing and chemical etching for zirconium and zirconium-uranium alloys. (auth)

410

PRODUCTION OF TITANIUM FROM $TiCl_4$ IN AN ARC FURNACE. L. D. Jaffe and R. K. Pitler. J. Metals. (N. Y.) 188, 1396(1950) Nov. (Technical Note)

A preliminary investigation has been made of the production of titanium by hydrogen reduction of the tetrachloride in an electric arc furnace. An arc furnace designed for the melting of titanium and lined with water-cooled copper was used for the preliminary experimental check. Its inside diameter was 2 7/16 in. and height 6 in. The water cooled electrode was tipped with 3/4 in. diameter tungsten. In the one run carried out, the furnace was charged with a starting batch of 293.35 g of scrap titanium, analyzing 99.24% Ti. The metal recovered contained 305.08 g Ti, as compared to 291.12 g in the starting batch. Titanium could not have been carried over from previous melting runs in the furnace, as the interior was sandblasted and the electrode ground clean before the run. Evidently at least 13.96 g of

Ti were produced from $TiCl_4$. Since this would require complete reduction of 430 liters of $TiCl_4$ gas at 12.6 mm of Hg, the efficiency of the process must have been rather high. Experimental work is continuing.

411

TRANSFORMATION CHARACTERISTICS OF A LITHIUM-MAGNESIUM ALLOY. C. S. Barrett and D. F. Clifton. J. Metals (N. Y.) 188, 1329-32(1950) Nov.

The martensite-type transformation curves for a lithium-magnesium alloy containing 12.4 atomic % Mg were determined by the x-ray spectrometer method. In fully annealed fine-grain specimens the M_s temperature (code used on chart), which was near 125°K, was slightly lower after annealing near 200°K than after annealing near 300°K, though the amount of the change was of the order of experimental error (2°). Tests for possible stabilization of the body centered cubic (b.c.c.) phase by annealing in the range 110 to 155°K during an interrupted cooling experiment disclosed no stabilization greater than the estimated error of the best individual experiments (½°). No stabilization of the low-temperature phase, h.c.p. (hexagonal close-packed), could be found after annealing at 145 to 173°K during interrupted heating experiments. After cooling below M_s, reversion to b.c.c. phase began slowly as soon as the temperature began to rise, but rapid reversion began only when a temperature M_r was reached, which was always higher than M_s. M_r and the entire reversion curve above M_r shifted to higher temperatures as the previous minimum temperature was decreased. When reversion was interrupted and the specimen again cooled, decomposition of the b.c.c. phase began at a temperature $M_{s'}$, which lay a few degrees above M_s, being higher the greater the per cent of the h.c.p. phase in the specimen; the rate of transformation with falling temperature below $M_{s'}$ was less than that for the original cooling through M_s. (auth)

412

VANADIUM MAKES ITS BID. Chem. Eng. 57, No. 11, 194-5(1950) Nov. (New Products)

A high purity, ductile vanadium metal is now available in limited quantities for fabrication and use by the metal industry according to an announcement by the Electro Metallurgical Division of Union Carbide and Carbon Corp. The metal averages above 99.8% vanadium and can be obtained in the form of ingots, plates, bars, sheets, and foil. It is also available in the form of chips for remelting into ingots of special sizes and shapes.

MINERALS AND MINERALOGY

413

OCCURRENCE OF RADIOACTIVE COLUMBITE IN TRAVANCORE. C. V. Paulose. Current Sci. (India) 19, 277-8(1950) Sept. (Letter to the editor)

Laboratory tests on a grey black mineral from Othara in Central Travancore, have revealed that it is columbite containing niobium as the major constituent element. The mineral has also been found to be radioactive. The detection and determination of its radioactivity was made by a sensitive α-ray electroscope. A comparison of the activity of the mineral with that of a sample of known uranium content, under identical conditions, has given the percentage of uranium equivalent in the mineral as 0.25.

414

Department of Mines and Resources (Canada)
THE PREPARATION OF STANDARD SAMPLES FOR FIELD ANALYSES. F. E. Senftle and C. R. Boyce. June 7, 1949. 3p. (NP-1602; Topical Report No. 25)

The standard samples of uranium ores supplied by the Bureau of Mines, Department of Mines and Resources, Ottawa, Canada, for calibration purposes in field analysis methods are described. Each set contains two standards containing 0.5 and 7.0% U_3O_8, respectively. These have been found adequate to standardize Geiger counters for use in field assays.

TRACER APPLICATIONS

415

M.I.T. Department of Metallurgy
ADAPTATION OF TRACER TECHNIQUES TO MINERAL ENGINEERING PROBLEMS. Mar. 15, 1950. 23p. (NYO-585)

Depression of Pyrite in Flotation and Synthesis of S^{35}-Marked Sulfide Minerals. A study of the depression of pyrite in flotation, utilizing Ca^{45} as the tracer element, has been undertaken. The intended experimental procedure is to determine the amount of calcium absorbed by a pyrite sample in equilibrium with a solution of known concentration. The radiochemical procedure involves measuring the activity of the pyrite coated with adsorbed Ca^{45} while allowing for the activity due to Ca^{45} that is in the entrapped solution.

Activation in Flotation. In an investigation of the effect of concentration of the influent solutions, 20 liters of radioactive 10^{-6} mole/liter silver nitrate solution were allowed to percolate through a sphalerite bed at a flow rate which averaged 12.3 ml/min. Analysis of the effluent samples of this test run showed no trace of any activity. This may be taken as evidence that all the silver in solution was taken up by the sphalerite.

Kinetics of Surface Reactions in Flotation. The radiochemical analysis for S^{35} in xanthate adsorbed on galena particles has been attempted by determination of activity on mineral surface directly and by removal of adsorbed xanthate from mineral surface into solution and subsequent precipitation of S^{35}

Synthesis of C^{14}-Labeled Dyes. m-Methoxy benzoic acid, 3,5-dimethoxy benzoic acid, and 3,4,5-trimethoxy benzoic acid containing radioactive carbon in the carboxyl group were prepared by means of the lithium compounds, prepared from the corresponding bromo derivatives, through radiocarbonation with carbon dioxide from active barium carbonate. The acids were condensed to form, respectively, anthracene blue WR, anthrachryson, and rufigallol.

Surface Measurement. The work on this problem has been presented as a topical report, NYO-548, MITS-6.

Flotation with Volatile Reagents. In a study of the flotation of sphalerite with mercaptans, rough checks on flotation of

minus 200-mesh sphalerite indicated that the hexyl mercaptan may be subject to depression somewhat in the same manner as the xanthates but perhaps not so much as potassium ethyl xanthate.

Neutron Activation of Ores for Picker Belt Separation. The possibility of activating certain ores by neutron bombardment and subsequently concentrating those parts which are rich in economically important minerals is discussed. The results of theoretical calculations based on 1 g of element, an irradiation time of 1 sec, and a flux of 10^9 neutrons/cm^2/sec, are shown graphically in a distribution curve of the number of radionuclides versus the log of the activity. The ten most easily activated elements in the foregoing calculations are Dy, In, Rh, Ag, Sc, Li, Ir, B, V, and Eu.

Adsorption of Dodecylamine Acetate on Hematite. The column method of adsorption tests was decided upon in preference to the agitation technique. Preliminary tests, in which dodecylamine acetate was simply mixed with the hematite and the mixture combusted, indicated that the presence of hematite did not interfere in any way with the combustion technique being used.

PHYSICS

416

Brookhaven National Laboratory
ANNUAL REPORT; JULY 1, 1950. July 1950. 147p. (BNL-74)

Part I of the document consists of an administrative report from the Associated Universities, Inc. Part II describes in general terms the technical work in progress. Considerations of neutron interactions, inelastic scattering from crystals, effects of high energy particles, applications of nuclear techniques, theoretical topics, compilations of nuclear data, precision electrical pulse-height measurements to give an indication of the energy of the radiation, range measurements, coincidence circuits, precision timer for a time-of-flight mass spectrometer, counter development and construction, health physics instruments, particle accelerators and their components, chemical effects of radiation and nuclear transformations, applications of nuclear tools to chemical problems, and study of nuclei are reported. Other activities concern reactor science and engineering, radioactive wastes, radioisotope production, the life sciences, medicine, radiation protection, direct services, and administration and maintenance.

417

M.I.T. Research Laboratory of Electronics
[SEVENTEENTH] QUARTERLY PROGRESS REPORT [FOR THE THREE-MONTH PERIOD ENDING MARCH 1, 1950]. A. G. Hill, J. B. Wiesner, and G. G. Harvey. Apr. 15, 1950. 91p. (NP-1563)

A review of the research activities of the Laboratory for the period is presented. Results are not considered to be final.

Physical Electronics. Results of electron-emission problems, studies with gaseous discharge, and experimental techniques involving spectral emissivity of tungsten, ionization gauge study and electronic circuits are reported.

Solid State Physics. Results of work on the theory of the transport phenomena in metals are summarized.

Low Temperature Physics. Cryostat operation and services are summarized. Activities concerning measurement of pressure variation of second sound velocity in liquid helium II, investigations of dipole interaction in crystals, the cooling of liquid helium by adiabatic demagnetization, the measurement of magnetic susceptibility of paramagnetic salts, and proposals for thermal or heat switches for use with apparatus for refrigeration below 1°K are outlined.

Radio-frequency Spectroscopy. Operations of a double mass spectrometer are described in experiments with Cs^{133} and Cs^{134}. An upper limit of 2.5×10^{-4} nuclear magnetons was assigned for the value of the nuclear magnetic moment of Cs^{134}. Optical detection of radio-frequency resonance in excited atomic states and factors influencing the positions of nuclear magnetic resonances are reported. A small iron magnet designed to be cooled by liquid nitrogen has been used at room temperatures to give resonances in oil. A simplified (null) circuit for nuclear magnetic resonance experiments which has the advantage of eliminating bulky half-wave lines or r-f transformers is described. Intensity measurements and line shapes of formaldehyde and precise Stark-effect measurements with the molecule carbonyl sulfide OCS have been carried out. The microwave absorption spectrum of HDS has been resolved and 12 absorption lines have been measured (including S^{34} isotopic HDS).

Tube Research and Development. Magnetron development, studies on microwave tubes, and the generation of millimeter and infrared radiation by accelerated electrons are covered.

Research concerning communications, problems of air navigation, and work with miscellaneous problems concerning an electronic differential analyzer, analog devices for network problems, etc., are also reported.

COSMIC RADIATION

418

A MAGNETIC COSMIC RAY SPECTROGRAPH WITH COUNTER RECORDING. B. D. Hyams, M. G. Mylroi, B. G. Owen, and J. G. Wilson. Proc. Phys. Soc. (London) 63A, 1053-74(1950) Oct. 1.

An instrument is described in which the momentum of single cosmic-ray particles is measured, the particles leaving the instrument in a sufficiently collimated beam for use in subsequent experiments. The "maximum detectable momentum" of the apparatus is about 3×10^{10} ev/c; almost all particles are collected within 10 deg of the zenith and in directions individually defined to ±1 deg;

the output is about 400 particles per day; and the proportion of spurious records is of the order of, or less than, 0.1 %. (auth)

419

A MAGNETIC COSMIC-RAY SPECTROGRAPH WITH COUNTER RECORDING. II. THE ELECTRONIC AND RECORDING SYSTEM. B. G. Owen. Proc. Phys. Soc. (London) 63A, 1074-80(1950) Oct. 1.

Following a general description of a magnetic cosmic-ray spectrograph given by Hyams et al. (see preceding abstract), the present author describes the electronic selection and recording systems of the instrument, and its performance and over-all serviceability as shown in continuous operation over about one year. (auth)

420

Princeton University
THE MEAN FREE PATH OF THE N COMPONENT OF THE COSMIC RADIATION. G. Salvini. [nd.]. 7p. (NP-1780; Technical Report No. 3)

It is shown that data obtained to date (from available literature) may still be internally consistent when due allowance is made for the limitations of the techniques used in obtaining the data. It is concluded that the collision mean free path in heavy nuclei such as Pb is close to the geometric mean free path.

421

OBSERVATIONS ON COSMIC-RAY PENETRATING SHOWERS AT HIGH ALTITUDE, SEA LEVEL, AND BELOW GROUND. E. P. George and A. C. Jason. Proc. Phys. Soc. (London) 63A, 1081-97(1950) Oct. 1.

Penetrating showers have been investigated, using Geiger counters, at a depth of 30 m below ground, at sea level, and at an altitude of 3457 m. The influence of the geometry of the absorbers was studied. The transition curves for local showers, corrected for this geometric effect, give the following collision lengths of the generating particles: Pb, 180 ± 40; Al, 85 ± 15; paraffin, ~80 g/cm^2. These values correspond to a collision cross section close to the geometric cross section of the nuclei. From the results obtained for extensive penetrating showers, it is concluded that most of the penetrating particles in these showers appear to be generated in the atmosphere. In 40 days, no penetrating showers were recorded below ground. Using photographic plates, the density distribution of shower tracks associated with nuclear disintegrations was found to be similar at sea level and 3457 m. (auth)

422

SLOW MESONS IN THE BACKWARD FLUX OF THE COSMIC RADIATION. D. M. Ritson. Proc. Phys. Soc. (London) 63A, 1098-1100(1950) Oct. 1.

Using the method of "delayed coincidences," measurements have been made on the flux of slow mesons traveling backwards from the ground. The ratio of the total backward to forward flux at sea level is of the order of 2×10^{-4}. The backward component is generated in local nuclear interactions. (auth)

423

AN UNUSUAL π-μ DECAY TRACK. D. Lal and H. J. Taylor. Nature 166, 607(1950) Oct.

The article is reproduced here in its entirety.

A photograph shows an event observed in an N.T.4 plate exposed for several hours at an altitude of some 90,000 ft in balloon flights made recently at Bangalore. The heavier track enters the emulsion from the air and gives rise to the lighter track after a path of 535 μ. The lighter track has a range of 571 μ and ends in the emulsion. The event can be identified with confidence as an example of π-μ decay. The grain densities are also consistent with this explanation. A remarkable feature of the event, however, is the sequence of three large-angle scatterings near the end of the track. The μ track originates at a distance of 2 μ from the third scattering, and passes slightly underneath the π track, thus forming a closed loop. The photograph shows the loop on a larger scale. The writers had not previously observed the formation of a closed loop by scattering, and the event seemed sufficiently curious to be worth recording.

ELECTRONS

424

M.I.T. Research Laboratory of Electronics
THE INFLUENCE OF A TRANSVERSE MAGNETIC FIELD ON THE CONDUCTIVITY OF THIN METALLIC FILMS. E. H. Sondheimer. May 31, 1950. 12p. (NP-1775; Technical Report No. 161)

The influence of a transverse magnetic field on the conduction properties of thin metallic films, of thickness comparable with the free path of the conduction electrons, is investigated. It is shown that, owing to scattering of electrons at the boundaries of the film, the Hall coefficinet is increased, and the electrical resistance oscillates with the strength of the applied magnetic field.

GASES

425

Westinghouse Research Laboratories
EVAPORATION AND OUTGASSING IN AN INERT ATMOSPHERE. H. L. Longini. Feb. 9, 1949. 12p. (NP-1616; Scientific Paper 1416)

A simple theory is developed concerning the effect of an inert gas on the rate of evaporation and outgassing of a body. Experimental procedures (evaporations of antimony in He atmosphere on microbalance) are used to evaluate constants. The results indicate that the presence of an inert gas may be advantageous for outgassing volatile materials.

426

THE ZEEMAN EFFECT IN OXYGEN. Allan F. Henry. Phys. Rev. 80, 396-401(1950) Nov. 1.

This paper describes the calculation of the energy of magnetic sublevels belonging to the $^3\Sigma$ state of O_2 in an external

magnetic field. A general secular determinant is derived, the roots of which yield the desired energies. The results are particularly useful in the investigation of levels associated with a low value of the rotational quantum number. The perturbation representing the external magnetic field is introduced together with the perturbations leading to the rotational triplets; thus the distortion of the rotational triplets is considered from the beginning of the calculation. The work is performed in two states to avoid the mathematical difficulties of treating a ninth-order secular determinant. Comparison between theory and experiment is satisfactory. (auth)

INSTRUMENTS

427

Los Alamos Scientific Laboratory
THE USE OF BETA-RAY DENSITOMETRY IN PAPER CHROMATOGRAPHY. Ralph H. Müller and Edward N. Wise. Nov. 7, 1950. 7p. (AECU-1011; LADC-884)

The absorption or scattering of a finely collimated beam of β rays may be used to locate and evaluate the various zones on a paper chromatogram, quite independently of the chemical nature of each component and depending primarily on its density. A densitometer for this purpose consisting of a narrowly collimated Sr^{90} source of β rays, a chromatogram sample holder, a methane-type ionization chamber, and a pulse-integrating counter which drives a Brown recorder has been built. Scale ranges vary in steps from 500 to 500,000 cpm for full-scale deflection on the recorder. A simple application of part of this equipment to the rapid analysis of labeled chromatograms is described.

428

Los Alamos Scientific Laboratory
MILLI-MICROAMPERE CURRENT INTEGRATOR FOR A CYCLOTRON. Richard J. Watts. Nov. 7, 1950. 10p. (AECU-1012; LADC-877)

A low-current integrator is described that successfully avoids the problem of current leakage by the use of electrometer tubes. In connection with the circuit, an electronic master switch is described which permits the turning on and off of associated equipment with the beginning of the charging cycle of the integrator. (auth)

429

Atomic Energy Research Establishment
THE CONVERSION OF A CONTROLLER FROM SINGLE TO MULTIPOINT OPERATION. R. D. Semmens. Sept. 1950. 11p. (AERE-M/R-576)

This report describes an electrical method of adapting a single-point controller or indicator-controller to the control of a number of furnaces or furnace zones at the same or (with further modification) different temperatures. The entire circuit is made up of reliable and relatively inexpensive standard post office type relays. (auth)

430

PREPARATION OF CARBON TARGETS. G. C. Phillips and J. E. Richardson. Rev. Sci. Instruments 21, 884-5 (1950) Oct. (Laboratory and shop notes.)

In investigating the $C^{12}(d,n)N^{13}$ and $C^{12}(d,p)C^{13}$ reactions in this laboratory, it was found necessary to prepare thin, pure carbon targets on light silver foils. A thin backing was needed to prevent the positrons from the N^{13} from backscattering and to enable observation of the long-range protons in the forward direction. A method of cracking benzene on silver which produces a pure, uniform carbon target free from the afore mentioned difficulties has been devised. A Hubert's Model 22 Deluxe oven was used to produce the temperature necessary to crack the benzene. A 3-mil silver foil was mounted on a silver disk and placed in a Vycor tube which was sealed at one end. The open end was connected to a bottle of benzene and a vacuum pump. The Vycor tube was evacuated and the pump was then applied to the benzene until all air over the benzene had been removed. The hose to the pump was closed, and the benzene vapor was allowed to fill the tube. Then the hose to the tube was closed, and the target end was inserted in the oven which had been preheated to 1500°F. With the oven held at this temperature, any number of targets can be prepared simultaneously in 6 to 7 min.

MASS SPECTROGRAPHY

431

Brookhaven National Laboratory
A NEW MAGNETIC PERIOD MASS SPECTROMETER. Lincoln G. Smith. July 10, 1950. 5p. (AECU-970)

An instrument is described wherein an electric field of small extent in space and time performs both the functions of forming pulses and of deflecting them so that they miss the source without the centers of their subsequent orbits having to move steadily either transversely or axially. Because of its superficial resemblance to a synchrotron and the employment therewith of a synchronous method of measuring masses, the name "synchrometer" is suggested for the instrument.

432

Brookhaven National Laboratory
ON THE RELATIVE EFFICIENCIES FOR THE COLLECTION OF POSITIVE IONS BY A 60° SECTOR MASS SPECTROMETER. Oliver A. Schaeffer. [nd.] 14p. (AECU-971)

The effects of voltage discrimination were investigated using a 60-deg sector type mass spectrometer. It was found that valid isotope ratios for krypton may be obtained by the use of magnetic scanning at accelerating voltages from 750 to 5000 volts, while electrostatic scanning gives erroneous abundances, except for high accelerating voltages. In the mass spectral pattern of a hydrocarbon such as propane, it is necessary to use magnetic scanning and a 4000-volt ion accelerating potential in order to obtain a pattern free from large discrimination errors. (auth)

433

Brookhaven National Laboratory
THE EFFECT OF ISOTOPIC SUBSTITUTION ON MASS SPECTRA OF MOLECULES. Oliver A. Schaeffer. [nd.] 20p. (AECU-974)

A general method for calculating the effect of isotopic substitution on mass spectra is presented. The calculation is

based on the notion that the various fragment ions formed by electron impact on a molecule are produced by a Franck-Condon mechanism. It is assumed that those bonds will break which possess more potential energy than bond energy at the instant of ionization. The mass spectral data for a molecule are used in conjunction with the ground-state vibrational wave function to evaluate critical bond distances (distances for which the potential energy equals the bond energy). Then the mass spectral pattern for isotopic molecules can be predicted from a knowledge of the ground-state vibrational wave function of the isotopic molecule. The method is applied to the diatomic molecules $N^{14}N^{14}$, $N^{14}N^{15}$, $N^{15}N^{15}$, and $C^{12}O^{16}$, $C^{13}O^{16}$. The predicted values compare favorably with previously observed results; however, experimental errors obscure a sharp test of the predictions for these cases. New experimental values are presented for the ratios $C^{13+}/C^{13}O_2^{16+}$ and $C^{12+}/C^{12}O_2^{16+}$ from carbon dioxide and are compared with predictions. Good agreement is found between ratios extrapolated to high ion-accelerating voltage and the predicted ones. (auth)

434

Brookhaven National Laboratory
THE EFFECT OF MASS DISCRIMINATION ON ISOTOPE ABUNDANCE MEASUREMENTS; RELATIVE ABUNDANCES OF KRYPTON ISOTOPES. Oliver A. Schaeffer. [nd.] 5p. (AECU-976)

In order to determine whether true isotope ratios, free from systematic discrimination errors, may be obtained with a 60-deg sector spectrometer, the abundances of the krypton isotopes were measured by scanning the masses magnetically at several ion-accelerating voltages from 750 to 5000 volts and by electrostatic scanning. There are no evident systematic trends in the magnetically scanned values. The electrostatically scanned value does, however, deviate quite appreciably from any of these values. The averaged magnetic scanning results agree, within the precision of the measurements, with Nier's most recent data (Nier, Phys. Rev. 78, 450(1950)), showing that isotope abundances free from discrimination errors may be measured directly by the use of magnetic scanning.

435

MASS SPECTRA OF SOME SIMPLE ISOTOPIC MOLECULES. Vernon H. Dibeler, Fred L. Mohler, Edmund J. Wells, Jr., and Robert M. Reese. J. Research Natl. Bur. Standards 45, 288-91(1950) Oct.

The mass spectra of H_2, D_2, HD, and HT have been measured with a Consolidated mass spectrometer with 50-volts ionizing voltage and with a constant magnetic field. The following ratios of atom ions to molecule ions were observed: $H^+/H_2^+ = 0.0201$, $D^+/D_2^+ = 0.0096$, $T^+/T_2^+ = 0.0061$, $H^+/HD^+ = 0.0096$, $D^+/HD^+ = 0.0097$, $H^+/HT^+ = 0.0085$, and $T^+/HT^+ = 0.0068$. The ratios of T_2 and HT were derived from spectra of two samples containing 91 and 37 at. % of T in equilibrium with H. Theoretical values for the ratios were computed for ionization involving transition into the Σ_g state of the molecule ion. These values are lower than the observed ratios because transitions to higher repulsive states contribute to the observed values at 50-volts ionizing voltage. Mass spectra of CO and CO_2 containing about 54 at. % C^{13} were measured under standard operating conditions. For CO the ratios are $C^{13+}/C^{12}O^+ = 0.0540$ and $C^{13+}/C^{13}O^+ = 0.0514$. For CO_2, the ratios are $C^{12}O^+/C^{12}O_2^+ = 0.0868$, $C^{13}O^+/C^{13}O_2^+ = 0.0824$, $C^{12+}/C^{12}O^+ = 0.0564$, and $C^{13+}/C^{13}O_2^+ = 0.0542$. A theory of the isotope effect in CO involving simplifying assumptions indicates that the relative probability of producing C^{12+} is 3.5 % greater than the probability of producing C^{13+}, as compared with an observed difference of 5%. 13 references. (auth)

436

R-F MASS SPECTROMETER TUBE. Rev. Sci. Instruments 21, 888(1950) Oct. (New Instruments)

New progress in the field of radio-frequency mass spectrometry is reported. Improved three-stage tubes are now commercially available, and complete spectrometers will become available soon. A new model of the Bennett r-f tube is shown in an accompanying photograph. The tube consists of a filament, 16 grids, and a collector plate, with the necessary leads and supports, enclosed in an evacuated glass envelope. Masses are sorted by the principle of velocity selection, as described previously (Rev. Sci. Instruments 21, 758(1950)).

MATHEMATICS

437

MONTE CARLO AT WORK. Ind. Bull. of Arthur D. Little, Inc. No. 270, 3-4(1950) Nov.

A mathematical technique is helping research workers predict the outcome of situations where large numbers of individual particles are influenced in their behavior partly by chance and partly by known or assumed principles. Called the "Monte Carlo method," the technique sets up a system of assumed methods or sequences of operations which serves as a model of the real situation. One application of the Monte Carlo method has been in studies of shielding against radioactivity in work on atomic energy. Neutrons from an atomic pile penetrate into concrete or water shields, and some get completely through. Using the Monte Carlo method, an investigator may follow the progress of a simulated neutron through the shield, and use the information on its ultimate fate in designing shields to keep escape of neutrons and other radiation to a safe level.

MEASURING INSTRUMENTS AND TECHNIQUES

438

Brookhaven National Laboratory
A GEIGER COUNTER MOUNTING FOR CONTINUOUS COUNTING OF GAS-PHASE RADIOACTIVITY. Francis Bonner and Alfred Weinstein. [nd.] 3p. (AECU-975)

A novel method for the mounting of apparatus used in an investigation of the carbon dioxide–carbon reaction (in which $C^{14}O_2$ and $C^{14}O$ were pumped over charcoal by thermal syphon and the radioactivity of the gas phase was continuously monitored with an end window Geiger tube) is described. Operational advantages are pointed out.

439

Los Alamos Scientific Laboratory
TARGET AND MULTIPLE CAMERA. [nd.] 23p. (AECU-994; LADC-650; LA-1088)

This report consists of drawings for a target and Multiple Camera as described in LA-1088, abstracted in NSA as abstract 4-5261.

440

Naval Radiological Defense Laboratory
THE RESPONSE OF GEIGER-MUELLER SURVEY INSTRUMENTS TO BETA-RAYS. E. Tochilin, A. B. Willoughby, and P. R. Howland. July 26, 1950. 24p. (AD-230(P))

The relative meter readings of commercial beta-gamma G-M type survey instruments exposed to equal rep doses have been investigated using beta isotopes with maximum energies from 0.5 to 3.0 Mev. Absolute dose rates were obtained by extrapolation chamber measurements. Theoretical and experimental curves are presented for two types of G-M instruments: instruments employing a cylindrical Eck and Krebs counter with wall thickness of 30 mg/cm^2, and instruments employing an end-window counter with window thickness approximating 0 mg/cm^2. In general, the rep response of both types of instruments agrees with the predicted values. (auth)

441

Naval Radiological Defense Laboratory
THE ESTIMATION OF DOSE IN TERMS OF A DOSAGE RATE MEASUREMENT IN AN ATOMIC BOMB RADIATION FIELD. H. F. Hunter. Aug. 11, 1950. 45p. (AD-234(H); Objective AW-07601)

The problem, given a dosage-rate measurement r at time t_m in a radiation field from an atomic bomb detonation, to estimate the dose d obtained by exposure from time t_1 to time t_2, is considered. The means of measurement and the biological significance of r are not considered in this report. In the absence of better knowledge, it is assumed that the dosage rate in the radiation field varies with time proportionally to the disintegration rate of the products of slow-neutron fission of U^{235}. Two forms of the resulting solution are presented: (1) two families of curves, the first giving the percentage p of "total dose" D versus $\Delta t = t_2 - t_1$ for various values of t_1, and the second giving "total dose" D versus dosage rate r for various times t_m of measurement of r; and (2) a circular slide rule (in envelope inside back cover). Mathematical derivations, discussions of error, example problem sets with answers, and a brief discussion of advantages and disadvantages of the various forms of solution are given. (auth)

442

University of California Radiation Laboratory
IMPROVEMENTS IN THE Li^6 TECHNIQUE. George R. Keepin, Jr. July 26, 1950. 28p. (UCRL-790)

Recent improvements made on the Li^6 technique are reported. The technique, employing observation of $Li^6(n,\alpha)H^3$ in Li^6-loaded plates to measure neutron energies is reviewed briefly, and the following improvements are discussed: new Q value for $Li^6(n,\alpha)H^3$, revised range-energy relations in Li^6-impregnated emulsions, improved discrimination, new shrinkage determination, revised plate processing procedure, and comparative accuracy for energy measurement of noncollimated neutrons under three different acceptance criteria. Although collimation is not required with this technique, when present it is shown to give maximum energy resolution. The region of applicability of the technique ($0<\alpha E_n < 5$ Mev) is established, and progress on a supplementary technique using B^{10}-loaded plates, is reported. (auth)

443

University of California Radiation Laboratory
EFFECTIVE PHOTON ENERGIES OF HIGH ENERGY PHOTO-NUCLEAR REACTIONS. Leonard Eyges. Sept. 7, 1950. 25p. (UCRL-903)

The use of shower theory to evaluate the effective energies of the photonuclear reactions measured by Strauch (Phys. Rev., in press, 1951) has been attempted. It seems that these energies can be determined most accurately from the area under the transition curve, the so-called "track length." A theoretical formula for the track length is discussed. The shape of the transition curve at small thicknesses can also be calculated quite accurately and serves as a rough check on the effective energies as derived from the track length. A comparison with experiment of the theoretical shape of the whole transition curve is given and, as one would expect, the agreement is not very good. (auth)

444

University of California Radiation Laboratory
HIGH ENERGY ELECTRON PROCESSES IN NUCLEAR EMULSION. F. C. Gilbert, Charles E. Violet, and Walter H. Barkas. Oct. 31, 1950. 1p. (UCRL-978)

This report is reproduced here in its entirety.

The existence of electron-sensitive emulsions and a technique for eradicating accumulated background has made possible the study of high-energy electron and positron processes taking place within the nuclear emulsion. Tracks of magnetically separated electrons and positrons of 200-Mev energy produced by the synchrotron have been studied. The length of track scanned is recorded, and each measurable event is analyzed. The following processes have been observed: (1) pair production by electrons and positrons, (2) electron-electron scattering, (3) positron-electron scattering, and (4) nuclear scattering of electrons and positrons. The absolute cross sections for these processes are being determined. The results will be reported and photographs of events shown.

445

Atomic Energy Project, Chalk River, Ontario
THE DETECTION OF ALPHA CONTAMINATION WITH SCINTILLATION COUNTERS. George Cowper. Aug. 1950. 21p. (CREL-453)

Three instruments are described for the detection of α particles by the scintillations produced in a zinc sulfide phosphor. Two are portable, one mains driven, the other battery driven. Both will be used for the detection of contamination in the laboratory. The third, which has a very low background counting rate, may be used for the examination of α activity in biological samples. (auth)

446

Atomic Energy Project, Chalk River, Ontario
THE DETECTION OF RADIOACTIVITY WITH SCINTILLATION COUNTERS. George Cowper. Aug. 1950. 11p. (CREL-454)

The detection of radioactivity by scintillation methods is described, and results using various phosphors irradiated with α particles, γ rays, and fast neutrons are shown. (auth)

447

A HIGH SPEED SHORT RESOLVING TIME COINCIDENCE CIRCUIT FOR USE WITH SCINTILLATION COUNTERS. E. F. Shrader. Rev. Sci. Instruments 21, 883(1950) Oct. (Laboratory and shop notes)

The usefulness of nonlinear circuit elements in coincidence circuits after the method of Morton (Nucleonics 4, 25(1949)) and Meyer et al. (Helv. Phys. Acta 22, 421 (1949)), especially when used with the scintillation-type counter, is indicated. Such coincidence circuits can be made to handle directly the wide distribution of pulse heights which in many cases is characteristic of this type of counter. They can also be made to operate in the pulse voltage range of the photomultiplier even when the photomultiplier is operated at conservative voltages. A modification of the Meyer circuit has been developed which realizes these two advantages to a high degree. Because the details of such a circuit have not been widely published, a description of one of the many possible variations of this circuit giving its capabilities and limitations is presented.

448

INSTRUMENTATION. Ralph H. Munch. Ind. Eng. Chem. 42, 93A-4A(1950) Nov.

Several new mass spectrometers have been developed for continuous monitoring of process streams. One, which is the magnetic deflection type but is provided with a continuous sampling system, scans only the tops of a few peaks of the mass range selected to give desired information, standardizes itself against a standard gas sample, and requires a minimum of maintenance, is described. Two other radio-frequency types of mass spectrometers are described.

449

Chemical Research Laboratory, Teddington
MEASUREMENT OF RADIOACTIVE CARBON (C^{14}) BY GAS COUNTING OF CARBON DIOXIDE. B. N. Audric and J. V. P. Long. Mar. 1950. 7p. (CRL-AE-51)

Copper cathode tubes have given satisfactory counting characteristics when filled with CO_2-Cs_2 mixtures and used in conjunction with a quench probe unit. The main advantages of gas counting over other methods appear to be increased accuracy and sensitivity with the added convenience that preparation and handling of barium carbonate precipitates can be very largely avoided.

450

ON THE TEMPERATURE DEPENDENCE OF COUNTER CHARACTERISTICS IN SELF-QUENCHING G. M. COUNTERS. Om Parkash. Current Sci. (India) 19, 273-5(1950) Sept. (Letter to the editor)

It is found necessary to test counters for their temperature dependence before using them in any standard work especially when the counters are to pass through varying conditions of temperature, and as a precautionay measure it is necessary to use a multivibrator circuit (J. L. Putman, Proc. Phys. Soc. (London) 61, 312(1948)) to eliminate any such effects.

451

PULSE AMPLIFIER FOR FAST IONIZATION CHAMBERS AND PROPORTIONAL COUNTERS. Electronic Eng. 22, 469(1950) Nov.

Specification 120 issued by the Atomic Energy Research Establishment, Harwell, describes the pulse amplifier Type 1049B, which has been designed primarily for use with fast ionization chambers and proportional counters. The upper half-power frequency of the amplifier is 2 Mc; therefore, the equipment is particularly useful for coincidence work and counting in the presence of high backgrounds. There are two units: a head amplifier which may have its maximum gain set to 100 for ionization chamber work or to 5 for proportional counter work and which also contains an E.H.T. filter unit; and a main amplifier with a maximum gain of 10,000 which contains all the necessary power supplies. The technical details of the two units are described.

452

RADIATION COUNTERS AID BRAIN TUMOR DIAGNOSIS. Richard G. Davis. Electronics 23, No. 11, 72-5(1950) Nov.

Differential radiation counters are reported which determine the position of accumulation of radioactive material which, when added to the bloodstream, collects in the vicinity of tumorous tissue. Brain tumor recognition and location is made possible in a matter of minutes. (auth)

453

ULTRAVIOLET PHOTON COUNTING WITH AN ELECTRON MULTIPLIER. A. H. Morrish, G. W. Williams, and E. K. Darby. Rev. Sci. Instruments 21, 884-5(1950) Oct. (Laboratory and shop notes)

It was thought that a photomultiplier sensitive to the ultraviolet might be useful in certain experiments. A multiplier, whose electrodes were fashioned from sheets of a beryllium-copper alloy after the design of J. S. Allen (Rev. Sci. Instruments 18, 739(1947)) was investigated and found to be photosensitive to light of wavelength below 2900 A. The tube was installed in a metal envelope which had a 3-mm quartz window situated approximately 1.75 in. in front of the first (photo) Be-Cu electrode. The recording equipment used in this experiment is similar to that used for particle counting, consisting of a pre-amplifier and linear amplifier with maximum gain of 5000. A commercial scale of 64 and mechanical register were used to count the pulses. The first electrode was operated at high negative potential and the collector close to ground potential. The source of ultraviolet light was the Beckman quartz photoelectric spectrophotometer used as a monochromator with a hydrogen lamp source. The beam from the monochromator was fed into the electron multiplier through the quartz window, along the axis of a bakelite tube. The precaution of using the bakelite tube proved unnecessary, since the tube was totally insensitive to light above 3000 A.

MESONS

454

University of California Radiation Laboratory
PRODUCTION OF π^+ MESONS BY X-RAYS AS A FUNCTION OF ATOMIC NUMBER. R. F. Mozley. June 22, 1950. 7p. (UCRL-706(Rev.))

The electronic method of meson detection developed by Steinberger and Bishop (Phys. Rev. 78, 493(1950)) has been used to study the relative cross sections of various elements for production of π^+ mesons by x rays. This study has been made at an angle of 90 ± 8 deg to the x-ray beam, at approximately 317-Mev synchrotron energy, and at meson energies of 42 ± 7 Mev and 76 ± 6 Mev. Reasons for the observed decrease of the cross section per proton with atomic number are discussed.

455

University of California Radiation Laboratory
THE GAMMA RAY SPECTRUM RESULTING FROM CAPTURE OF NEGATIVE π MESONS IN HYDROGEN AND DEUTERIUM. Wolfgang K. H. Panofsky, R. Lee Aamodt, and James Hadley. Sept. 26, 1950. 45p. (UCRL-814(Rev.))

The π^- mesons produced in an internal tungsten target bombarded by 330-Mev protons in the 184-in. cyclotron are absorbed in a high-pressure hydrogen target. The resulting γ-ray spectrum is analyzed outside the shielding of the cyclotron by means of a 30-channel electron-positron pair spectrometer. The principal results are as follows: (1) the γ rays result from two competing reactions: $\pi^- + p \rightarrow n + \gamma$ and $\pi^- + p \rightarrow n + \pi^0$; $\pi^0 \rightarrow 2\gamma$; (2) the ratio between the π^0 yield to the single γ-ray yield is 0.94 ± 0.20; (3) the mass difference between the π^- meson and the π^0 meson is given by 10.6 ± 2.0 electron masses; (4) the π^- mass is 275.2 ± 2.5 electron masses. The large mass difference between π^- and π^0 precludes the conclusion that the unexpectedly small π^0 to γ ratio is due to the small amount of momentum space available for π^0 emission. It rather indicates that π^0 emission is slowed down by the nature of the coupling of the π^0 field to the nucleons. The experiment has been repeated by substituting D_2 for H_2 in the vessel. The result is that the reaction $\pi^- + D \rightarrow 2n$ and $\pi^- + D \rightarrow 2n + \gamma$ compete in the ratio 2:1. The reaction $\pi^- + D \rightarrow 2n + \pi^0$ is absent. (auth)

456

University of California Radiation Laboratory
THE ANALYSIS OF π MESON PRODUCTION IN NUCLEON-NUCLEON COLLISIONS. Kenneth M. Watson and Keith A. Brueckner. Aug. 22, 1950. 45p. (UCRL-856)

The data which have been obtained on the production of mesons in the collisions of two nucleons is very incomplete, yet it is sufficient to establish a number of interesting features of these processes. There seems to be enough quantitative information to warrant the development of a rational, coherent interpretation of the processes of meson production in nucleon collisions. The present paper sketches the outline of such a means of interpretation on the basis of a semiphenomonological theory in the hope of obtaining a unified picture of the processes under consideration. The theory developed should also be of assistance in the study of meson production in complex nuclei (which is not considered in the present paper, however) and in the comparison of the inverse process of meson absorption. Some of the qualitative experimental information on meson production which has been obtained at this laboratory is given. From the qualitative knowledge of these results it is possible to deduce approximately the nucleon-nucleon cross sections for meson production. It was pointed out by Brueckner et al. (Phys. Rev., in press) that the production of mesons in nucleon-nucleon collisions is strongly dependent on the interaction of the nucleons in the final state. In the course of applying the theory of the present paper, the calculations of these authors have been extended. A suggested means of deducing the nature of the meson-nucleon couplings for meson production by nucleon collisions is also given.. 10 figures.

457

University of California Radiation Laboratory
THE PHOTOPRODUCTION OF MESONS FROM HYDROGEN. Amasa Stone Bishop. Aug. 24, 1950. 72p. (UCRL-874)

In an effort to gain information on the nature of the photon-meson and photon-nucleon interaction, a study of the artificial production of mesons by photons has been made at the Berkeley synchrotron. The major effort of this research was concentrated on a measurement of the energy and angular distribution of π^+ mesons produced when the photons strike a target of liquid hydrogen. Detection of the mesons is accomplished electronically by the technique of delayed coincidence. Since the photons are completely absorbed in the process of meson creation ($\gamma + p \quad n + \pi^+$), conservation of energy and momentum requires that, for a given angle of emission of meson, there be an exact relationship between the energy of the meson and the energy of the photon responsible for its creation. Thus, from the measured energy distribution of the mesons at 90 deg and the theoretical energy distribution of the photons from the synchrotron, it is possible to determine the excitation function for photoproduction of mesons at 90 deg. This excitation function increases rather slowly from threshold and flattens off somewhat with increasing photon energy. Modification of the data which may be required as a result of nuclear absorption is indicated. The angular distribution of mesons was measured for a single photon energy of 250 Mev, the absorber thickness being varied with the angle of measurement. This distribution is seen to be roughly isotropic but peaked slightly in the backward direction. Included in this report is an outline of the several meson theories developed to date, with graphs of the energy and angular distributions of photomesons predicted on the basis of some of these theories. The experimental data are then compared with the results of these various theories. Such a comparison provides evidence that π^+ mesons have zero spin and that they are tightly coupled to nucleons. These properties are consistent with the pseudoscalar meson theory. 26 figures.

458

University of California Radiation Laboratory
LARGE ANGLE SCATTERING OF π^- MESONS. H. Bradner and B. Rankin. Sept. 12, 1950. 3p. (UCRL-910)

In an investigation of the mean free path for large angle scattering and nuclear interaction of π^- mesons in G-5 emulsion, mesons entering the edge of a plate with approximately 38-Mev energy are identified by measurement of

grain density versus small angle scattering. These mesons are then followed for several millimeters until they leave the 600 μ-thick emulsion or reach an energy of 30 Mev. A tabulation of scattering angle versus meson energy is made for 135 events. The average nuclear area for the elements in a G-5 emulsion is equivalent to a mean free path of 23 cm. It appears that the cross section for large angle scattering of 20 to 38 Mev π^- mesons in emulsion is roughly equal to ½ nuclear area, while the cross section for star production is smaller.

459

University of California Radiation Laboratory
PRODUCTION OF A π^+ MESON BEAM USING THE DEFLECTED PROTON BEAM OF THE 184-INCH SYNCHROCYCLOTRON. C. Richman, M. Skinner, B. Youtz, and J. Merritt. Aug. 30, 1950. 16p. (UCRL-922)

The production of a meson beam using the deflected 340-Mev proton beam from the Berkeley 184-in. synchrocyclotron is described. By making use of the large peak in the forward-angle meson-production cross section for protons on portons, an intense, fairly clean, and monochromatic beam has been produced. With a polyethylene target 5-cm thick and magnetic separation of mesons and protons, a fairly well collimated beam of about 5000 mesons per second, issuing from a channel whose exit area is 2 in. by 2.5 in. has been obtained. The peak of the energy spectrum of the meson beam occurs at 53.5 Mev and the half-width of the peak is 5 Mev. (auth)

METEOROLOGY

460

ATMOSPHERIC POLLUTION. Louis C. McCabe. Ind. Eng. Chem. 42, 115A-116A(1950) Nov. (See also NSA 4-5958.)

The results of a 2-year study on air contaminants and techniques for micro-sampling are reported by the Los Angeles Air Pollution Control District. Results of infrared absorption, mass spectrometer, and chemical analyses of samples are reported.

MOLECULAR STRUCTURE

461

Iowa State College
ELECTRON DEFICIENT COMPOUNDS. V. THE STRUCTURE OF DIMETHYLBERYLLIUM. R. E. Rundle and A. I. Snow. May 25, 1950. 3p. (ISC-87)

This report was abstracted and indexed as AECU-844; see NSA 4-4826.

NEUTRONS

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Argonne National Laboratory
A METHOD FOR INTERCALIBRATING OF NEUTRON SOURCES WITH DIFFERENT SPECTRA. A. Wattenberg and C. Eggler. Sept. 28, 1950. 7p. (AECD-3002)

The method used at the Argonne National Laboratory since 1945 for intercalibrating neutron sources is described. While this method is applicable only in laboratories having a subcritical nuclear reactor, it has the advantage of intercalibrating sources with different energy spectra so that the correction for the energy will be of the order of 2% or less. The sources are placed in a standard position in a subcritical pile and the counting rate of a fixed BF_3 counter is observed.

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NEPA Division
THE DIFFUSION OF ISOTROPICALLY SCATTERED NEUTRONS THROUGH STRONGLY ABSORBING MEDIA. W. G. Bouricius. Nov. 14, 1949. 22p. (NEPA-1192)

The simple diffusion equation for neutrons is valid only when the change in the gradient of the flux is small through a mean free path. In a strongly absorbing medium, near a source, or near a boundary between two differing media, a correction is necessary. Up to now this correction has been derived from transport theory and has been intermingled with a second correction which is necessary when there is a spatial change in the angular distribution of the neutrons, which change occurs near a source or near a boundary between two differing media. The present work was undertaken to see what could be done to make diffusion theory valid for strongly absorbing media. It proved possible to derive an infinite-order differential equation involving multiple Laplacians. This equation in turn proved amenable to reduction to a second-order differential equation, so that most of the techniques and solutions worked out in the past need only slight, but vital, modification to be applied to the infinite-order equation here derived. The importance of the ratio of the absorption cross section to the scattering cross section is pointed out and emphasized by giving it a special symbol, B. The solution of the reduced equation is found, together with expressions for the total current, the positive and negative current, the albedo, and the extrapolation distance. Useful tables and approximations valid for particular ranges of B are included. Throughout, comparisons with the results of transport theory are included, and a complete agreement is noted. To illustrate further the necessary techniques, a few specific problems are solved. (auth)

NUCLEAR PHYSICS

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Atomic Energy Research Establishment
PROCEEDINGS OF THE HARWELL NUCLEAR PHYSICS CONFERENCE. E. W. Titterton, ed. Sept. 1950. 124p. (AERE-G/M-68)

A record of the discussions held at the International Nuclear Physics Conference in Oxford and Harwell, England, during September 1950 is presented. Sessions were held in the following categories: high energy machines, high energy physics (experimental and theoretical), energy levels of light nuclei, transmutations of light nuclei, angular distribution experiments, photodisintegration, and pile physics. Alternative sessions were held on techniques (including counting techniques), α- and β-ray spectroscopy, neutron spectroscopy, theoretical physics, and field theory.

465

SOURCEBOOK ON ATOMIC ENERGY. Samuel Glasstone. New York, D. Van Nostrand Company, Inc., 1950. 546p.

The important facts regarding the past history, present status, and possible future of atomic energy are presented in an authoritative, reliable, and quite readable manner. Concepts in nuclear science, inherently complex, are brought within the grasp of readers unfamiliar with the field. Beginning with the earliest theories of the atom, the book concludes with a timely chapter on radiation protection and health physics.

NUCLEAR PROPERTIES

466

University of California Radiation Laboratory
VARIATION WITH ENERGY OF NUCLEAR COLLISION CROSS SECTIONS FOR HIGH ENERGY NEUTRONS. J. DeJuren and B. J. Moyer. Aug. 30, 1950. Decl. Oct. 23, 1950. 19p. (AECD-2987; UCRL-887)

Nuclear total cross sections [of H, Al, Cu, C, Pb, and U] for high-energy neutrons have been measured for approximately known neutron energies in the range 90 to 270 Mev. It is observed that cross sections in every case drop rather rapidly between 100 and 180 Mev to a level which continues with little further variation up to the highest neutron energies available in the experiment. Comparisons are made with nuclear attenuation data for cosmic rays. (auth)

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Argonne National Laboratory
NUCLEAR INDUCTION MEASUREMENTS; THE MAGNETIC MOMENT OF THE DEUTERON. H. L. Anderson, B. Smaller, and E. Yasaitis. Oct. 19, 1950. 13p. (AECU-1019; UAC-320)

A series of determinations of the ratio of the magnetic moment of the deuteron to that of the proton is reported, and the results are compared with those of previous investigators. A precise nuclear-induction apparatus, which is described in some detail, was used, and great effort was taken to eliminate or minimize sources of error. H_2O and D_2O were used as the source of the respective nuclei. The weighted mean ratio given is 3.25720013 ± 0.00000037.

468

CAPTURE CROSS SECTIONS FOR FAST NEUTRONS. R. L. Henkel and H. H. Barschall. Phys. Rev. 80, 145-9 (1950) Oct. 15. (See also NSA 4-3168.)

The fast neutron capture cross section of Al^{27} was measured by observing the induced 2.3-min activity of Al^{28} for neutron energies between 10 and 550 kev. Resonances were observed which showed some correlation with scattering resonances so that radiation widths of some of the levels could be estimated. Measurements of activation cross sections were also carried out for F, V, Cu^{65}, Ag, I, In^{115}, and Au. The apparatus and geometries used for fast and thermal neutron activations are illustrated, and curves of total and capture cross sections versus neutron energy are given for Al and F.

NUCLEAR REACTORS

469

North American Aviation, Inc.
NUMERICAL COMPUTATION OF NEUTRON DISTRIBUTION AND CRITICAL SIZE. A. S. Thompson. Feb. 15, 1950. (Decl. Oct. 26, 1950). 28p. (AECD-2988; NAA-SR-48 (Rev.)

A numerical procedure is presented for the calculation, by diffusion theory, of the critical size of a nuclear reactor, and of the time dependent distribution of neutrons in the reactor as a function of position (one-dimensional space) and neutron energy. The partial differential equations for diffusion theory are approximated by a system of ordinary differential equations, for which a step by step convergent solution for neutron distribution is obtained. The critical size of the reactor is found from a comparison of the magnitude of the slowing down densities of the thermal and fission energy limits. The procedure is applied, by way of example to a reflected sphere. This method for calculating neutron distribution is thought to be new in that an integration technique is developed and used for the solution instead of differentiation. Primarily because of this, the convergence to the correct solution is rapid. In a one-dimensional space all physical quantities can be considered as either continuous or discontinuous functions of both position and energy. Such items as fission and nonproductive capture in the slowing down range can be included as part of a standardized procedure. Certain transient and steady state perturbationlike motions of control rods can be studied. (auth)

NUCLEAR TRANSFORMATION

470

Iowa State College
PREPARATION OF Co^{58m} BY A (γ,n) REACTION. Darleane Christian and Don S. Martin, Jr. [nd.] 3p. (AECU-1013)

Co^{58m} has been prepared by a (γ,n) process in irradiations of $K_3Co(C_2O_4)_3 \cdot 3H_2O$ in the 65-Mev beam of the Iowa State College synchrotron. High specific activity was obtained by a Szilard-Chalmers decomposition of the Co(III) complex induced by the recoil from the nuclear reaction. In this process the radioactive atoms were converted to the Co(II) oxidation state which could then be separated chemically from the target material. The decay was followed with a windowless, gas-flow G-M counter. A half life of 9.2 ± 0.2 hr was observed for the short-lived component. This radiation was completely stopped by a 2-mg/cm² aluminum absorber. A portion of the target salt was mounted for counting under standard conditions and the decay of C^{11} was followed. The half life checked the previously reported value, 20.5 ± 0.5 min. Using the C^{11} as an "internal standard," a tentative ratio for the cross section for the formation of Co^{58m} to the cross section for C^{11} was estimated to be 2.5.

471

University of Rochester
EXCITATION OF NUCLEI BY FAST NUCLEONS; TECHNICAL REPORT NO. V OF THE 130-IN. CYCLOTRON. S. A. Wouthuysen. 1950. 14p. (NP-1534)

A model for the excitation of heavy nuclei by protons having energies in the bev region is given. It is assumed that these

protons can make several collisions in a heavy nucleus, like Ag, of which the first two are accompanied by meson production, which makes them highly inelastic and degrades the energy so quickly that after these two inelastic collisions a primary proton of energy between 4.5 and 30 mc^2 (including the rest energy) has given rise to four nucleons of between 150- and 600-Mev kinetic energy, or to two of these plus one particle of between 600-Mev and 3.5-bev kinetic energy, together with a number of mesons. It is assumed that the collisions are completely inelastic. The two or four "slow" particles will, on their way out of the nucleus, heat it up, emerging with hardly diminished energies, while the heated nucleus, left over after the eventual direct knockons of the heating particles have left, evaporates the excess energy into proton or neutron prongs or heavier fragments. The multiple collision probabilities, transition effect in an absorber, excitation energy of stars, probabilities for production of first- and second-generation particles, depth distribution of the particles, energy loss for each path length, and excitation curve are computed.

472

Atomic Energy Research Establishment
PHOTODISINTEGRATION OF THE ALPHA-PARTICLE AND THE INVERSE PROCESSES. B. H. Flowers and F. Mandl. Sept. 1950. 15p. (AERE-T/R-575; HD-403)

The partial cross sections for photodisintegration of the α particle are calculated in the usual first-order perturbation theory approximation, utilizing the symmetry properties of the wave functions of the α particle and of the various product nuclei. From these results the cross sections for radiative capture of protons by H^3, neutrons by He^3, and deuterons by deuterons can be deduced. It is found that (a) the yield of γ rays from the $H^3(p,\gamma)He^4$ reaction should increase with bombarding energy up to several Mev, (b) the radiative capture cross section of He^3 for thermal neutrons should be negligible, and (c) the radiative cross section for the D + D reaction should be smaller than that for the T + P reaction at corresponding energies by a factor of about 10^{-3}. Conclusion (a) is discussed in the light of recent experiments by Taschek et al., which purport to establish the existence of an excited state of the α particle. (auth)

PARTICLE ACCELERATORS

473

Oak Ridge National Laboratory
ON ELECTRIC FOCUSING IN THE FIXED FREQUENCY CYCLOTRON. M. E. Rose. Oct. 13, 1950. 11p. (ORNL-849)

The theory of electric focusing in the fixed-frequency cyclotron has been discussed quite completely by Rose (Phys. Rev. 53, 392(1938)). The present report presents an alternative method of obtaining the orbit equation in which the nature of the approximations is brought out more clearly.

474

University of California Radiation Laboratory
THE PROTON DEUTERON R-F SYSTEM FOR THE BERKELEY SYNCHROCYCLOTRON. K. R. MacKenzie. Aug. 15, 1950. 27p. (UCRL-855)

A r-f system is described which allows the acceleration of either 190-Mev deuterons or 350-Mev protons in the Berkeley 184-in. cyclotron. The dee is connected to a large cross section line, which is in turn connected, through a rotating condenser, to a short section of grounded line of approximately the same cross section. At the upper frequency limit of 23.2 Mc the dee and dee stem oscillate as a half-wave line, while the grounded line, which is about one-quarter wave long, oscillates in the opposite phase. At the low frequency limit of 9.5 Mc, the whole system looks like a quarter-wave line. The oscillator that feeds the system is described. (auth)

475

University of California Radiation Laboratory
MULTIPLE TRANSVERSALS OF HIGH ENERGY PARTICLES IN A CYCLOTRON BEAM THROUGH THIN TARGETS. W. J. Knox. Sept. 1, 1950. 21p. (UCRL-883)

An experimental determination has been made of the average numbers of times that 340-Mev protons traverse various targets in the Berkeley 184-in. cyclotron. The numbers range from slightly above 1 for a 1-in.-thick copper target to about 15 for an aluminum target 0.0015 in. thick. The results are compared with calculated values based on multiple scattering in the target and oscillations of the particles in the cyclotron. It is believed that the results can be adapted to apply to various particles of different energies in the cyclotron. Calculations are made on the energy distribution of beam particles which cause reactions in a target, and distributions are shown for several targets. The selection of targets for the production of high-energy neutron beams is discussed. Histograms are presented showing the depth of radial penetration of the 340-Mev proton beam into various targets. (auth)

476

University of Chicago Institute for Nuclear Studies
170-INCH SYNCHROCYCLOTRON; PROGRESS REPORT III; JULY 1949 - JULY 1950. Herbert L. Anderson and John Marshall. 1950. 154p. (NP-1767)

Progress in the construction of the 170-in. synchrocyclotron during the third year is recorded. The magnet was in operation during most of the year. Extensive studies of the magnetic field distribution were made. Azimuthal asymmetries in the magnetic field were found and the magnet pole faces were shimmed to correct for the undesirable effect of these on the beam. The major part of the vacuum system was put into operation, and the main vacuum chamber was evacuated to 2×10^{-6} mm. The radiofrequency system was completed and assembled in the New York Naval Shipyard but has not yet been delivered to the building. The problem of extracting the beam was studied and a new method for accomplishing this is being developed. This method utilizes suitably shaped iron pieces which so perturb the orbits that the particles can be led out of the magnetic field in a magnetic channel.

RADIATION ABSORPTION AND SCATTERING

477

Argonne National Laboratory
ESTIMATION OF SELF ABSORPTION IN NEUTRON-

IRRADIATED SAMPLES. Robert Keyes. Sept. 1950. 6p. (AECD-3000; ANL-4475 (EXCERPT))

The permissible sample size in neutron irradiations in nuclear reactors is limited by self-absorption in the sample. Approximate solutions for the self-absorption of spherically and cylindrically symmetric geometries are obtained and an example is evaluated numerically. The following conditions have been assumed: small absorption in the sample, negligible scattering in the sample, only scattering in the surrounding medium, and monoenergetic neutrons.

478

Iowa State College, Ames Laboratory
IONIZATION DEFECTS OF FISSION FRAGMENTS. J. K. Knipp, R. B. Leachman, and R. C. Ling. [nd.] 4p. (AECU-977; Contribution 126)

The mean total kinetic energy of fission fragments produced from U^{235} by thermal neutrons is still a quantity of considerable uncertainty. Estimates based on ionization yields are appreciably less than the only direct (calorimetric) measurement. Evidence is presented that about 2.5 Mev for the average light fragment and about 4.2 Mev for the average heavy fragment escape detection in the usual ionization experiments. These ionization defects occur because the light fragment loses about 5 Mev, and the heavy fragment about 8 Mev, to recoiling gas atoms which themselves have a reduced ionization efficiency because they in turn produce recoil atoms, etc. An equation is presented for the ionization defect of a heavy particle stopped in a gas. Numerical integration of this equation based on certain approximations leads to 0.94 and 0.975 as probable values of the ionization efficiencies in argon gas of the heavy and light fission fragments from U^{235} by thermal neutrons. The remarkable agreement with that found from analysis of fragment pair distributions must be regarded as largely accidental, because of the approximate nature of both considerations.

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Iowa State College, Ames Laboratory
IONIZATION BY RECOIL PARTICLES FROM ALPHA DECAY. Rufus C. Ling and Julian K. Knipp. [nd.] 4p. (AECU-980)

Since the energy loss of a slow heavy particle is predominantly to recoiling gas atoms, ionization by secondary heavy particles contributes a large fraction of the total ionization resulting from a slow heavy particle that is stopped in a gas. A differential-integral equation for the ionization efficiency of a primary particle is given, and is applied to the problem of a heavy particle (Z = 82, M = 208 proton masses) in argon. It is found that about 66% of the ionization by a recoil particle from natural alpha decay is heavy-particle secondary ionization.

480

Saint Louis University
TRANSMISSION OF BETA RAYS BY NYLON AND FORMVAR. R. B. Heller, E. F. Sturcken, and A. H. Weber. Sept. 30, 1950. 17p. (AECU-1002)

The per cent β-ray transmission by Nylon and Formvar films (windows) was studied to obtain experimental "absorption" corrections to be used with G-M counters employing such thin windows. It was found that window "absorption" included (1) energy loss of electrons traversing the films, and (2) scattering of incident electrons by the film (a geometry effect). The results are plotted in several ways to exhibit the various factors involved and to permit easy use in applying the corrections. It was found that scattering of transmitted electrons was a factor of considerable importance whereas the energy lost in traversing the film was not greatly important for the range investigated. The electron energy range investigated was limited to the region in which the "absorption" correction was considerable for the window thicknesses used. (auth)

481

Columbia University Radiological Research Laboratory
DISTRIBUTED BETA SOURCES IN UNIFORMLY ABSORBING MEDIA. Harald H. Rossi and R. Hobart Ellis, Jr. [nd.] 46p. (NYO-1509)

Approximate values of dose and flux of β particles may be computed if a β-emitting isotope is uniformly distributed in a limited region of a medium, and if such a "distributed source" has one of a number of simple geometric shapes. For the purposes of these approximations, the absorption of β rays is assumed to be exponential. Absorption coefficients are suggested for β spectra of maximum energies between 0 and 1.7 Mev. In a series of practical examples the relations found for simple shapes are applied to cases involving more complicated geometries. The results of these computations may be useful in assaying the dose due to β particles originating from isotopes which are not continuously distributed in biological systems.

482

University of California Radiation Laboratory
90 MEV NEUTRON-PROTON SCATTERING AT LARGE PROTON ANGLES. Roger Wallace. Sept. 2, 1950. 27p. (UCRL-869)

Neutron-proton scattering with 90-Mev neutrons has been investigated by Hadley et al. (Phys. Rev. 75, 351(1949)) and by Brueckner et al. (Phys. Rev. 75, 555(1949)) using a proportional counter technique and also using a cloud chamber. They measured the scattering cross section for neutrons for center-of-mass angles from 36 to 180 deg. The present experiment was an attempt to overlap the data of Hadley et al. from 74 to 36 deg and to extend the cross section measurements to smaller angles. This experiment was performed with nuclear emulsions in order to permit the detection of protons down to about 1.5 Mev, and to avoid systematic errors that might be present in the case of other methods of detection. The results agree with those of Hadley et al., within the probable error, and the cross section curve exhibits beyond 36 deg the same general trend as the curve measured by Hadley et al. The measurements confirm the fact that there is probably not complete symmetry of the n-p cross-section curve about 90 deg in the center-of-mass system. (auth)

RADIOACTIVITY

483

University of California Radiation Laboratory
THE L X-RAY SPECTRA FROM RADIOACTIVE DECAY

OF TRANSURANIUM ELEMENTS. G. W. Barton, Jr., H. P. Robinson, and I. Perlman. July 28, 1950. 27p. (UCRL-841)

A bent-crystal x-ray spectrometer is described, and some results are given on the analysis of L-series x rays produced in radioactive decay processes of transuranium elements. There is generally good agreement between measured energy values of L-series lines and those predicted by the Moseley relation. The relative intensities of the various lines produced in this case from γ ray internal conversion are compared with those emitted from uranium excited by electron bombardment and values reported of internal conversion excited x rays in the region of lead. (auth)

484

University of California Radiation Laboratory
SUMMARY OF THE RESEARCH PROGRESS MEETING OF AUGUST 31, 1950. Henry P. Kramer. Sept. 15, 1950. 10p. (UCRL-902)

Alpha-Activities in the Rare Earth Region. F. L. Reynolds. An attempt is reported to ascertain the exact mass numbers of rare-earth α activities by means of a mass spectrograph. The 4.5-hr Tb activity has been assigned the mass number 149. The collection was carried out on a photographic emulsion and α activity was counted by placing the collection plate face-to-face to a nuclear emulsion and then counting the α tracks on the sensitive plate. The second mass assignment in the rare earth region was that of the naturally α-active samarium isotope. It was thought that most likely the isotope with 147 nucleons is the natural α emitter. Sm^{147} was milked from Pm^{147} and allowed to decay for about a year. The α activity was examined on a pulse-height analyzer and agreed well with the natural activity. The sample was then analyzed on the mass spectrograph and observed to have the mass number 147.

Stars in Photographic Emulsions Initiated by Protons. L. Germain. Highly sensitive nuclear emulsion plates were exposed for short times by dropping them through the cyclotron proton beam. In this fashion exposures were kept to a legible 20 tracks per field of view. Energy discrimination was provided by different thicknesses of Al absorber. The average number of prongs per star as a function of energy is given. The only conclusion which the statistics permit is that the average number of prongs increases with energy. The cross section for star formation per atom of emulsion as a function of energy has been calculated on the basis of the number of atoms per cc of emulsion. Here again the accuracy of the experiment permits no more detailed conclusion than that the cross section for star formation increases with the energy of the incident particle.

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University of California Radiation Laboratory
DETERMINATION OF THE HALF-LIFE OF Ra^{227}. Robert L. Folger. [nd.] 1p. (UCRL-937)

This report is reproduced here in its entirety.

A uranium target was bombarded for approximately 1 hr with 190-Mev deuterons. 1.5 mg of Ba was used to carry the Ra through chemical purification. The Ba and Ra were separated on an ion-exchange column by elution with 0.5M citrate at pH 7.75 (Tompkins, AECD-1998, Oct. 1947). The Ra fraction was located by means of its α decay. Ra^{223} and Ra^{224} were identified by α-pulse analysis. Geiger decay of the Ra fraction showed the presence of an ~2-hr β emitter with β energy in the region 0.7 to 1.2 Mev. This isotope appears to be the predicted, short-lived Ra^{227}.

486

ON THE BRANCHING OF ACTINUM A AND ON THE LONG-RANGE RADIATION OF THE ACTIVE DEPOSIT OF ACTINIUM. Paul Avignon. J. phys. radium 11, 521-3 (1950) Aug.-Sept. (In French).

The following results are reported of a study of those emissions from a RdAc(Th^{227}) source which exceed the range of the α radiation of AcC' (Po^{211}, 7.434 Mev). A β decay in the branching of AcA(Po^{215}), observed by Karlik et al. (Z. Physik 123, 51(1944)), was confirmed. Values of the energy of α rays from the resulting At^{215} agree with those given by Perlman et al. (Phys. Rev. 75, 314(1949)). The energy of the long-range α radiation of the active deposit is 9.1 Mev, the number of rays emitted being 0.9×10^{-7} per 1 AcC(Bi^{211}) disintegration. (auth)

487

ON THE RADIATIONS FROM Co^{60}. Maurice Duquesne, Georges Kayas, and Gérard-André Renard. Compt. rend. 231, 693-5(1950) Oct. 9. (In French)

A Co^{60} source of high specific activity was prepared by irradiation of cobaltihexamine nitrate in the Châtillon pile, and the absorption, after complete decay of the 10.7-min isotope, of the β radiation in aluminum was studied. A decay component of low energy (~50 kev) has been found, the intensity of which is of the order of 30% of that of the principal spectrum. Coincidence measurements and magnetic spectroscopy have proved that this soft radiation consists of conversion electrons.

488

RADIOACTIVITY INDUCED IN WATER. Michael Sivetz. Atomics (Chicago) 6, No. 5, 4-18(1950) Sept.-Oct.

This article presents quantitative examples of artifically induced radioactivity, how it is formed in water, how long it exists, and how the intensity of radiation varies with time. The basic equations for induced activities on recycling reactor cooling fluids are developed and their use is explained. 10 references.

RARE EARTHS AND RARE EARTH COMPOUNDS

489

THE PRINCIPAL MAGNETIC SUSCEPTIBILITIES OF SINGLE CRYSTALS OF RARE EARTH SALTS AT LOW TEMPERATURE. PART IV. SAMARIUM SALTS. A. Mookherji. Indian J. Phys. 23, 445-52(1949) Oct.

The principal susceptibilities of samarium salts have been measured from 300 to 85°K. The results are discussed in the light of crystal field theory. It has been found that the magnetic anisotropy of cerium, praseodymium, and neo-

dymium salts increases as temperature is lowered, whereas in samarium salts it increases at first, then passes through a maximum and decreases. (auth)

SPECTROSCOPY

490

APPARATUS FOR LOW TEMPERATURE STUDY OF THE RAMAN EFFECT. R. C. Lord and E. Nielsen. J. Optical Soc. Am. 40, 655-7(1950) Oct.

A simple modification of a conventional excitation unit for the Raman effect is described that allows study of the effect in liquids at temperatures down to about −150°C. The chief feature of the arrangement is a Dewar-jacketed sleeve that fits around the Raman tube and enables the cooling of the tube by a flow of cold nitrogen gas. By adjustment of the temperature of the gas and its rate of flow, easy and precise control of the temperature of the Raman tube can be obtained. It is also possible to use elevated temperatures (up to 150°C) by heating the nitrogen. The advantages of the system are its simplicity, ease of operation, rapidity of change from low temperature to normal operation, and vice versa, and the same intensity of illumination as that afforded by room-temperature operation. (auth)

491

ON THE EXISTENCE OF ELECTRONIC BANDS IN THE INFRARED SPECTRUM OF URANIUM (III) AND (IV); THEIR RELATION TO THE SPECTRUM OF PLUTONIUM. Raymond Rohmer, René Freymann, Adélaïde Chevet, and Pierre Hamon. Compt. rend. 231, 347-9(1950) July 31. (In French)

A table is given of electronic bands in the near infrared spectrum of aqueous and organic solutions of the following uranium salts: UBr_4, UCl_3, UCl_4, UO_2Cl_2, and $UO_2(NO_3)_2$. In aqueous solutions, U(III) and U(IV) exhibit bands characteristic for each of these valence states; in organic solvents, UCl_4 presents numerous bands absent from the aqueous-solution spectrum; U(VI) has no bands in the infrared. In view of the latter result, it is probable that Pu bands, which have been attributed to Pu(VI) by Betts and Harvey (J. Chem. Phys. 16, 1089(1948)), should be considered as belonging to Pu(IV), their position being very close to that of the U(IV) bands.

492

ROTATION-VIBRATION SPECTRUM OF THE HD MOLECULE. G. Herzberg. Nature 166, 563(1950) Sept. 30. (Letter to the editor)

The HD spectrum in the photographic infrared has been observed using the technique of long optical paths. A glass absorption tube 5 m long was filled with HD at 1 atm pressure. Using approximately 140 and 200 traversals, that is, absorbing paths of 700 and 1000 m, 7 and 6 lines, respectively, were found of the 3-0 and 4-0 bands of HD (second and third overtone) near 9650 and 7400 A. Rotational and vibrational constants of HD have been derived directly from the observed wave numbers.

THEORETICAL PHYSICS

493

ASYMPTOTIC EXPANSION OF IRREGULAR COULOMB FUNCTION FOR ANGULAR MOMENTUM ZERO. G. Breit and M. H. Hull, Jr. Phys. Rev. 80, 392-5(1950) Nov. 1.

A justification is given for an expansion of the irregular Coulomb function, usually by G_0, in terms of Bessel functions of the second kind with an imaginary argument. This expansion has been considered speculatively by Yost, Wheeler, and Breit (Phys. Rev. 49, 174(1936)) and explicitly verified by Breit and Bouricius (Phys. Rev. 75 1029(1949)) for a number of terms. A general rule of replacement of the Bessel functions of the first kind with an imaginary argument in the corresponding expansion of the regular Coulomb function is here established. The formulas developed are convenient for the calculation of coefficients of the energy. (auth)

494

GRAPHICAL REPRESENTATION OF PARTICLE TRAJECTORIES IN A MOVING REFERENCE SYSTEM. M. Garbuny. J. Applied Phys. 21, 1054-6(1950) Oct.

A graphical method is derived for the analysis of microwave electron tubes, ion accelerators, etc, which refers particle positions and velocities to a moving reference system. If the forces are dependent on time only, the trajectories are transformed into straight lines. For inhomogeneous fields an approximation procedure applies. To demonstrate the capabilities of this method a brief treatment of the transit time phenomena in cavity triodes is outlined. (auth)

495

HYDRODYNAMICS OF NUCLEAR DIPOLE OSCILLATIONS. Helmut Steinwedel and J. Hans Jensen. Z. Naturforsch. 5a, 413-20(1950) Aug. (In German)

Following the suggestion of Goldhaber and Teller (Phys. Rev. 74, 1046(1948)), the recently discovered resonances in (γ,x) processes (x = p, n, 2n, or fission) are interpreted as dipole oscillations of a "proton liquid" relative to a "neutron liquid." The Hook forces determining the frequencies are deduced, without any arbitrary parameters, from a plausible treatment of a semiempirical formula for binding energies in stable nuclei. The result is a rather unusual hydrodynamics, which, however, is conveniently derived from the Hamiltonian principle and is easily integrable. In the simplest approximation, (i.e., by neglecting total-density changes, the coupling with surface oscillations, and the effect of Coulomb-energy perturbations), the resonance frequencies are found to be about 30% smaller than those actually observed; however, their trend with changing mass numbers agrees with experiment, and furthermore, the results can be improved by passing to closer approximations. The problem of cross sections for absorption and resonance scattering of γ rays is discussed. (auth)

496

ON THE DISCRIMINATION BETWEEN PARTICLES AND ANTIPARTICLES OBEYING DIRAC'S EQUATION.

M. Markov. Zhur. Eksptl. i Teoret. Fiz. 20, 286(1950) Mar. (Letter to the editor; in Russian)

Doubts have been expressed about the possibility of discriminating between neutral particles and antiparticles, as can be done in the case of electrons and positrons which obey Dirac's equation. However, the question has a meaning only in terms of an interaction of a given particle with a field; thus, in the absence of an electromagnetic field an electron and a positron are indistinguishable. It is shown that, in a meson field, neutrons and antineutrons are distinguishable in Dirac's equation. As an example, a proton in a certain state is attracted by a neutron (forming a deuteron), and is repulsed by an antineutron. It is concluded from similar considerations that the neutrino and the antineutrino are different in their relation to β forces.

497

ON THE NEGATIVE ENERGY PHOTON HYPOTHESIS. Tamotsu Awano. J. Phys. Soc. Japan 5, 316-21(1950) Sept.-Oct.

The theory of the negative-energy photon has been considered according to Schwinger's covariant formalism. The electromagnetic proper mass of the electron has been calculated by Schwinger's method, and it is found to be divergent. A discussion of the impossibility of combining the negative-energy photon hypothesis with the λ-limiting process in the interaction representation is given.

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ON A NEW FORM OF THE THEORY OF THE "SUBTRACTION FIELD." Louis de Broglie. J. phys. radium 11, 481-9(1950) Aug.-Sept. (In French)

The theory of the "subtraction field" has been published by the author in Compt. rend. 229, 157, 269, 401, and 640 (1949). It is presented here in a new form, and it is shown how the theory accounts for interactions between elementary particles and both photon and meson fields. The matrix elements of the interaction are given a shape that is relativistically satisfactory, and a study is made of the effect of corrections so introduced on the convergence of integrals used in the calculation of self-energies. By using Feynman's computations (Phys. Rev. 74, 939(1948)), an estimate is then made of the electron mass increments resulting from that particle's interaction with the photon and meson fields; the values obtained appear to be acceptable. (auth)

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ON NORMALIZATION AND MEAN-VALUE FORMULAS AND ON THE PHOTON AND PARTICLES OF SPIN GREATER THAN ½. Serge Slansky. Compt. rend. 231, 404-06(1950) Aug. 7. (In French)

Certain peculiarities of the theory of particles of spin 1 or >1, considered as formed from several ½-spin particles, can be explained with the aid of a description that uses a different time for each particle in a system. These peculiarities of the theory are explained by the difference between the density of the probability of localizing a particle in space-time and the density in ordinary space. (auth)

500

ON RADIATIONS EMITTED BY AN ATOM PLACED IN THE SPACE BETWEEN TWO PARALLEL REFLECTING PLANES. A. Lubny-Gertsyk. Zhur. Eksptl. i Teoret. Fiz. 20, 127-31 (1950) Feb. (In Russian)

The problem of the reverse action of a field on a quantized radiating system has recently been frequently examined. However, the emitting atom is usually assumed to be placed in a limitless space. In the author's opinion, some aspects of the problem could be clarified if the case is examined when the atom is placed symmetrically between two parallel reflecting planes. A calculation of the radiation intensity and of the frequency shift showed that the quantum-theoretical formula for the intensity coincides with the classical one, provided both are expressed in terms of damping decrements in a radiating system placed in a limitless space; as to the frequency shift, a simple relationship exists between the classical expression of that shift in an oscillator and the quantum formula for the term frequency.

501

THE PHYSICAL CONTENT OF THE 5-OPTICS. Yu. B. Rumer. Zhur. Eksptl. i Teoret. Fiz. 20, 199(1950) Mar. (In Russian)

The problem of a unified theory of gravitation and electricity is often considered as lying outside the path of modern physics, being a survival of pre-quantum times, and a mere formal unification of Einstein's and Maxwell's equations. Such an impression is natural, since in the known attempts by Einstein and co-workers the supplementary 5th space coordinate, (of which, however, the components of the metric 5-tensor must be independent), lacks all physical meaning. The present author has given a different theory, called 5-optics (Zhur. Eksptl. i Teoret. Fiz. 19, 86-207(1949), NSA abstracts 4-1272, 4-1273), in which the 5th (real) space coordinate is action. He shows here the physical purport of his theory. The central problem of physics at the present day is the behavior of ultrahard γ rays and ultrafast β particles, because it is here that theory parts with the facts, and because these phenomena are closely connected with the problem of nuclear forces. There has been a tendency to introduce an ever-growing number of various particles, in an attempt at an explanation of new phenomena, (reminiscent of the accumulation of mechanical models in 19th century physics). In the light of the 5-optics, photons and electrons suffice; they have to be considered, in the foregoing ultrahard or rapid conditions, as being in "heavy" states.

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POLARIZATION CORRELATION OF MIXED MULTIPOLES. Irving Zinnes. Phys. Rev. 80, 386-92(1950) Nov. 1.

The directional polarization results of Hamilton (Phys. Rev. 58, 122(1940)) are extended to cases in which one of the two photons emitted by a nucleus is described by a pure 2^L multipole and in which the second is described by two mixed multipoles. The correlation parameters Q, R, S, $\cdots$ obtained from a correlation experiment without polarization are insufficient to describe a polarization correlation experiment when mixtures are involved. A table of polarization correlation functions is given for all pure-mixture transitions up to and including octupoles. Two examples briefly indicating how this table may be used, and a table of some useful combinations of the elements of the representations of the three-dimensional rotation group are included.

503

QUANTUM-ELECTRODYNAMICAL SELF-ENERGY AND EXACT SOLUTIONS OF SCHRÖDINGER'S EQUATION. Part I. H. Salecker. Z. Naturforsch. 5a, 431-8(1950) Aug. (In German)

A method for the treatment of the degeneration in quantum theory of wave fields is introduced and the effect of the degeneration on the self-energy of the electron examined; it is found that the new procedure does not affect the usual results of the theory. The source of the divergence of self-energy is then investigated. With the aid of perturbation considerations, it is shown with several simple examples that the divergence of the exact expression for the self-energy level does not simply follow from the divergence of the second approximation. A strict examination of divergence difficulties in quantum electrodynamics shows that their source lies in the fundamental principles of the theory, viz., that the Schrödinger equation involved lacks solutions for finite energy eigenvalues. This result applies also to the covariant formuation recently given by Tomonaga and Schwinger. (auth)

504

THE QUESTION OF THE REACTION OF A CHARGED PARTICLE'S OWN FIELD. E. S. Fradkin. Zhur. Eksptl. i Teoret. Fiz. 20, 211(1950) Mar. (In Russian)

The question on the possibility for a charged particle to perform movements (e.g., oscillations) under the influence of its own field has been discussed recently and generally answered in the affirmative (Markov, Zhur. Eksptl. i Teoret. Fiz. 9, 800(1946); Bohm et al., Phys. Rev. 74, 1789(1948)). It is shown that these assertions were incorrect; the only possible movement of a charged particle in the absence of external forces is the uniform rectilinear.

URANIUM AND URANIUM COMPOUNDS

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Atomic Energy Research Establishment
THE MAGNETIC SUSCEPTIBILITIES AND ELECTRONIC STRUCTURES OF THE HALIDES OF TER- AND QUADRIVALENT URANIUM. J. K. Dawson. Sept. 1950. 4p. (AERE-C/R-578; HD-402)

Uranium tetrafluoride, tetrachloride, and tetrabromide obey the Weiss-Curie law over the temperature range 77 to 550°K. The values obtained for the magnetic moment of the quadrivalent uranium ion indicate that in these compounds the ion has a $5f^2$ electron configuration. Uranium trichloride, tribromide, and triiodide deviate from the Weiss-Curie law below about 350°K and are antiferromagnetic; the results are interpreted as arising from a $5f^26d^1$ electron configuration for the tribromide and triiodide, but the electron assignment is not conclusive for the trichloride. (auth)